



STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES

Division of Facilities Construction and Management

DFCM

STANDARD LOW BID PROJECT

June 26, 2008

USOR ALTERNATE DATA CENTER IMPROVEMENTS

**OFFICE OF EDUCATION
SALT LAKE CITY, UTAH**

DFCM Project Number: 08230200

WHW Engineering
8619 South Sandy Parkway #101
Sandy, Utah 84070

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Current copies of the following documents are hereby made part of these contract documents by reference. These documents are available on the DFCM web site at <http://dfcm.utah.gov> or are available upon request from DFCM.

DFCM Supplemental General Conditions dated May 5, 2008
DFCM General Conditions dated May 25, 2005.
DFCM Application and Certification for Payment dated May 25, 2005.

Technical Specifications & Drawings: WHW Engineering

The Agreement and General Conditions dated May 25, 2005 have been updated from versions that were formally adopted and in use prior to this date. The changes made to the General Conditions are identified in a document entitled Revisions to General Conditions that is available on DFCM's web site at <http://dfcm.utah.gov>

NOTICE TO CONTRACTORS

Sealed bids will be received by the Division of Facilities Construction and Management (DFCM) for:

USOR ALTERNATE DATA CENTER IMPROVEMENTS
OFFICE OF EDUCATION – SALT LAKE CITY, UTAH
DFCM PROJECT NO: 08230200

Bids will be in accordance with the Contract Documents that will be available at 5:00 PM on Thursday, June 26, 2008, and distributed in electronic format only on CDs from DFCM, 4110 State Office Building, Salt Lake City, Utah and on the DFCM web page at <http://dfcm.utah.gov>. For questions regarding this project, please contact Jim Russell, DFCM, at 801-231-3489. No others are to be contacted regarding this bidding process. The construction estimate for this project is \$200,000.00.

A **mandatory** pre-bid meeting will be held at 3:00 PM on Tuesday, July 1, 2008 at the Judy Buffmire Building, 1595 West 500 South, Salt Lake City, Utah. All bidders wishing to bid on this project are required to attend this meeting.

Bids will be received until the hour of 3:00 PM on Thursday, July 10, 2008 at DFCM, 4110 State Office Building, Salt Lake City, Utah 84114. Bids will be opened and read aloud in the DFCM Conference Room, 4110 State Office Building, Salt Lake City, Utah. NOTE: Bids must be received at 4110 State Office Building by the specified time.

A bid bond in the amount of five percent (5%) of the bid amount, made payable to the Division of Facilities Construction and Management on DFCM's bid bond form, shall accompany the bid.

The Division of Facilities Construction and Management reserves the right to reject any or all bids or to waive any formality or technicality in any bid in the interest of DFCM.

DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT
Marla Workman, Contract Coordinator
4110 State Office Building, Salt Lake City, Utah 84114

PROJECT DESCRIPTION

Convert existing office space into an Alternate Data Center for USOR. This project shall include: interior office remodel and carpet replacement; upgrade of the existing electrical service, including the installation of a new Owner-provided emergency generator and transfer switches; providing power for critical and emergency electrical systems; and demolition of existing floors for the installation of under floor electrical duct and data receptacles.



STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES
Division of Facilities Construction and Management

DFCM

PROJECT SCHEDULE

PROJECT NAME: USOR ALTERNATE DATA CENTER IMPROVEMENTS OFFICE OF EDUCATION – SALT LAKE CITY, UTAH DFCM PROJECT NO. 08230200				
Event	Day	Date	Time	Place
Bidding Documents Available	Thursday	June 26, 2008	5:00 PM	DFCM 4110 State Office Bldg SLC, UT and the DFCM web site *
Mandatory Pre-bid Site Meeting	Tuesday	July 1, 2008	3:00 PM	Judy Buffmire Building 1595 West 500 South SLC, UT
Last Day to Submit Questions	Thursday	July 3, 2008	2:00 PM	Jim Russell – DFCM E-mail jimrussell@utah.gov Fax 801-538-3267
Addendum Deadline (exception for bid delays)	Tuesday	July 8, 2008	2:00 PM	DFCM web site *
Prime Contractors Turn In Bid and Bid Bond	Thursday	July 10, 2008	3:00 PM	DFCM 4110 State Office Bldg SLC, UT
Sub-contractor List Due	Friday	July 11, 2008	3:00 PM	DFCM 4110 State Office Bldg SLC, UT Fax 801-538-3677
Substantial Completion Date	Friday	September 19, 2008		

* NOTE: DFCM's web site address is <http://dfcm.utah.gov>



STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES

Division of Facilities Construction and Management

DFCM

BID FORM

NAME OF BIDDER _____ DATE _____

To the Division of Facilities Construction and Management
4110 State Office Building
Salt Lake City, Utah 84114

The undersigned, responsive to the "Notice to Contractors" and in accordance with the "Instructions to Bidders", in compliance with your invitation for bids for the **USOR ALTERNATE DATA CENTER IMPROVEMENTS OFFICE OF EDUCATION – SALT LAKE CITY, UTAH - DFCM PROJECT # 08230200** and having examined the Contract Documents and the site of the proposed Work and being familiar with all of the conditions surrounding the construction of the proposed Project, including the availability of labor, hereby proposes to furnish all labor, materials and supplies as required for the Work in accordance with the Contract Documents as specified and within the time set forth and at the price stated below. This price is to cover all expenses incurred in performing the Work required under the Contract Documents of which this bid is a part:

I/We acknowledge receipt of the following Addenda: _____

For all work shown on the Drawings and described in the Specifications and Contract Documents, I/we agree to perform for the sum of:

_____ DOLLARS (\$_____) (In case of discrepancy, written amount shall govern)

I/We guarantee that the Work will be Substantially Complete by **September 19, 2008**, should I/we be the successful bidder, and agree to pay liquidated damages in the amount of **\$2,000.00** per day for each day after expiration of the Contract Time as stated in Article 3 of the Contractor's Agreement.

This bid shall be good for 45 days after bid opening.

Enclosed is a 5% bid bond, as required, in the sum of _____

The undersigned Contractor's License Number for Utah is _____.

Upon receipt of notice of award of this bid, the undersigned agrees to execute the contract within ten (10) days, unless a shorter time is specified in the Contract Documents, and deliver acceptable Performance and Payment bonds in the prescribed form in the amount of 100% of the Contract Sum for faithful performance of the contract.

The Bid Bond attached, in the amount not less than five percent (5%) of the above bid sum, shall become the property of the Division of Facilities Construction and Management as liquidated damages for delay and additional expense caused thereby in the event that the contract is not executed and/or acceptable 100% Performance and Payment bonds are not delivered within the time set forth.

Type of Organization:

(Corporation, Partnership, Individual, etc.)

Any request and information related to Utah Preference Laws:

Respectfully submitted,

Name of Bidder

ADDRESS:

Authorized Signature

INSTRUCTIONS TO BIDDERS

1. Drawings and Specifications, Other Contract Documents

Drawings and Specifications, as well as other available Contract Documents, may be obtained as stated in the Invitation to Bid.

2. Bids

Before submitting a bid, each contractor shall carefully examine the Contract Documents, shall visit the site of the Work; shall fully inform themselves as to all existing conditions and limitations; and shall include in the bid the cost of all items required by the Contract Documents. If the bidder observes that portions of the Contract Documents are at variance with applicable laws, building codes, rules, regulations or contain obvious erroneous or uncoordinated information, the bidder shall promptly notify the DFCM Representative and the necessary changes shall be accomplished by Addendum.

The bid, bearing original signatures, must be typed or handwritten in ink on the Bid Form provided in the procurement documents and submitted in a sealed envelope at the location specified by the Invitation to Bid prior to the deadline for submission of bids.

Bid bond security, in the amount of five percent (5%) of the bid, made payable to the Division of Facilities Construction and Management, shall accompany bid. **THE BID BOND MUST BE ON THE BID BOND FORM PROVIDED IN THE PROCUREMENT DOCUMENTS IN ORDER TO BE CONSIDERED AN ACCEPTABLE BID.**

If the bid bond security is submitted on a bid bond form other than DFCM's required bid bond form, and the bid security meets all other legal requirements, the bidder will be allowed to provide an acceptable bid bond by the close of business on the next business day following notification by DFCM of submission of a defective bid bond security. **NOTE: A cashier's check cannot be used as a substitute for a bid bond.**

3. Contract and Bond

The Contractor's Agreement will be in the form found in the specifications. The Contract Time will be as indicated in the bid. The successful bidder, simultaneously with the execution of the Contract Agreement, will be required to furnish a performance bond and a payment bond, both bearing original signatures, upon the forms provided in the procurement documents. The performance and payment bonds shall be for an amount equal to one hundred percent (100%) of the contract sum and secured from a company that meets the requirements specified in the requisite forms. Any bonding requirements for subcontractors will be specified in the Supplementary General Conditions.

4. Listing of Subcontractors

Listing of Subcontractors shall be as summarized in the “Instructions and Subcontractor’s List Form”, which are included as part of these Contract Documents. The Subcontractors List shall be delivered to DFCM or faxed to DFCM at (801)538-3677 within 24 hours of the bid opening. Requirements for listing additional subcontractors will be listed in the Contract Documents.

DFCM retains the right to audit or take other steps necessary to confirm compliance with requirements for the listing and changing of subcontractors. Any contractor who is found to not be in compliance with these requirements is subject to a debarment hearing and may be debarred from consideration for award of contracts for a period of up to three years.

5. Interpretation of Drawings and Specifications

If any person or entity contemplating submitting a bid is in doubt as to the meaning of any part of the drawings, specifications or other Contract Documents, such person shall submit to the DFCM Project Manager a request for an interpretation thereof. The person or entity submitting the request will be responsible for its prompt delivery. Any interpretation of the proposed documents will be made only by addenda posted on DFCM’s web site at <http://dfcm.utah.gov>. Neither the DFCM nor A/E will be responsible for any other explanations or interpretations of the proposed documents. A/E shall be deemed to refer to the architect or engineer hired by DFCM as the A/E or Consultant for the Project.

6. Addenda

Addenda will be posted on DFCM’s web site at <http://dfcm.utah.gov>. Contractors are responsible for obtaining information contained in each addendum from the web site. Addenda issued prior to the submittal deadline shall become part of the bidding process and must be acknowledged on the bid form. Failure to acknowledge addenda may result in disqualification from bidding.

7. Award of Contract

The Contract will be awarded as soon as possible to the lowest, responsive and responsible bidder, based on the lowest combination of base bid and acceptable prioritized alternates, provided the bid is reasonable, is in the interests of the State of Utah to accept and after applying the Utah Preference Laws in U.C.A. Title 63, Chapter 56. DFCM reserves the right to waive any technicalities or formalities in any bid or in the bidding. Alternates will be accepted on a prioritized basis with Alternate 1 being highest priority, Alternate 2 having second priority, etc.

8. DFCM Contractor Performance Rating

As a contractor completes each DFCM project, DFCM, the architect/engineer and the using agency will evaluate project performance based on the enclosed “DFCM Contractor Performance Rating” form. The ratings issued on this project will not affect this project but may affect the award on future projects.

9. Licensure

The Contractor shall comply with and require all of its subcontractors to comply with the license laws as required by the State of Utah.

10. Permits

In concurrence with the requirements for permitting in the General Conditions, it is the responsibility of the Contractor to obtain the fugitive dust plan requirements from the Utah Division of Air Quality and the SWPPP requirements from the Utah Department of Environmental Quality and submit the completed forms and pay any permit fee that may be required for this specific project. Failure to obtain the required permit may result in work stoppage and/or fines from the regulating authority that will be the sole responsibility of the Contractor. Any delay to the project as a result of any such failure to obtain the permit or noncompliance with the permit shall not be eligible for any extension in the Contract Time.

11. Right to Reject Bids

DFCM reserves the right to reject any or all Bids.

12. Time is of the Essence

Time is of the essence in regard to all the requirements of the Contract Documents.

13. Withdrawal of Bids

Bids may be withdrawn on written request received from bidder prior to the time fixed for opening. Negligence on the part of the bidder in preparing the bid confers no right for the withdrawal of the bid after it has been opened.

14. Product Approvals

Where reference is made to one or more proprietary products in the Contract Documents, but restrictive descriptive materials of one or more manufacturer(s) is referred to in the Contract Documents, the products of other manufacturers will be accepted, provided they equal or exceed the standards set forth in the drawings and specifications and are compatible with the intent and purpose of

the design, subject to the written approval of the A/E. Such written approval must occur prior to the deadline established for the last scheduled addenda to be issued. The A/E's written approval will be in an issued addendum. If the descriptive material is not restrictive, the products of other manufacturers specified will be accepted without prior approval provided they are compatible with the intent and purpose of the design as determined by the A/E.

15. Financial Responsibility of Contractors, Subcontractors and Sub-subcontractors

Contractors shall respond promptly to any inquiry in writing by DFCM to any concern of financial responsibility of the contractor, subcontractor or sub-subcontractor.

16. Debarment

By submitting a bid, the Contractor certifies that neither it nor its principals, including project and site managers, have been, or are under consideration for, debarment or suspension, or any action that would exclude such from participation in a construction contract by any governmental department or agency. If the Contractor cannot certify this statement, attach to the bid a detailed written explanation which must be reviewed and approved by DFCM as part of the requirements for award of the Project.

BID BOND

(Title 63, Chapter 56, U. C. A. 1953, as Amended)

KNOW ALL PERSONS BY THESE PRESENTS:

That _____ hereinafter referred to as the "Principal," and _____, a corporation organized and existing under the laws of the State of _____, with its principal office in the City of _____ and authorized to transact business in this State and U. S. Department of the Treasury Listed, (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); hereinafter referred to as the "Surety," are held and firmly bound unto the STATE OF UTAH, hereinafter referred to as the "Obligee," in the amount of \$ _____ (5% of the accompanying bid), being the sum of this Bond to which payment the Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH that whereas the Principal has submitted to Obligee the accompanying bid incorporated by reference herein, dated as shown, to enter into a contract in writing for the _____ Project.

NOW, THEREFORE, THE CONDITION OF THE ABOVE OBLIGATION IS SUCH, that if the said principal does not execute a contract and give bond to be approved by the Obligee for the faithful performance thereof within ten (10) days after being notified in writing of such contract to the principal, then the sum of the amount stated above will be forfeited to the State of Utah as liquidated damages and not as a penalty; if the said principal shall execute a contract and give bond to be approved by the Obligee for the faithful performance thereof within ten (10) days after being notified in writing of such contract to the Principal, then this obligation shall be null and void. It is expressly understood and agreed that the liability of the Surety for any and all defaults of the Principal hereunder shall be the full penal sum of this Bond. The Surety, for value received, hereby stipulates and agrees that obligations of the Surety under this Bond shall be for a term of sixty (60) days from actual date of the bid opening.

PROVIDED, HOWEVER, that this Bond is executed pursuant to provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the above bounden parties have executed this instrument under their several seals on the date indicated below, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

DATED this _____ day of _____, 20_____.

Principal's name and address (if other than a corporation):

By: _____

Title: _____

Principal's name and address (if a corporation):

By: _____

Title: _____
(Affix Corporate Seal)

Surety's name and address:

By: _____
Attorney-in-Fact (Affix Corporate Seal)

STATE OF _____)
COUNTY OF _____) ss.

On this ____ day of _____, 20_____, personally appeared before me _____, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney-in-fact of the above-named Surety Company, and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this _____ day of _____, 20_____.

My Commission Expires: _____

Resides at: _____

Agency: _____
Agent: _____
Address: _____
Phone: _____

NOTARY PUBLIC

Approved As To Form: May 25, 2005
By Alan S. Bachman, Asst Attorney General

**Division of Facilities Construction and****INSTRUCTIONS AND SUBCONTRACTORS LIST FORM**

The three low bidders, as well as all other bidders that desire to be considered, are required by law to submit to DFCM within 24 hours of bid opening a list of **ALL** first-tier subcontractors, including the subcontractor's name, bid amount and other information required by Building Board Rule and as stated in these Contract Documents, based on the following:

DOLLAR AMOUNTS FOR LISTING

PROJECTS UNDER \$500,000: ALL FIRST-TIER SUBS \$20,000 OR OVER MUST BE LISTED
PROJECTS \$500,000 OR MORE: ALL FIRST-TIER SUBS \$35,000 OR OVER MUST BE LISTED

- Any additional subcontractors identified in the bid documents shall also be listed.
- The DFCM Director may not consider any bid submitted by a bidder if the bidder fails to submit a subcontractor list meeting the requirements of State law.
- List subcontractors for base bid as well as the impact on the list that the selection of any alternate may have.
- Bidder may not list more than one subcontractor to perform the same work.
- If there are no subcontractors for the job that are required to be reported by State law (either because there are no subcontractors that will be used on the project or because there are no first-tier subcontractors over the dollar amounts referred to above), then you do not need to submit a sublist. If you do not submit a sublist, it will be deemed to be a representation by you that there are no subcontractors on the job that are required to be reported under State law. At any time, DFCM reserves the right to inquire, for security purposes, as to the identification of the subcontractors at any tier that will be on the worksite.

LICENSURE:

The subcontractor's name, the type of work, the subcontractor's bid amount, and the subcontractor's license number as issued by DOPL, if such license is required under Utah Law, shall be listed. Bidder shall certify that all subcontractors, required to be licensed, are licensed as required by State law. A subcontractor includes a trade contractor or specialty contractor and does not include suppliers who provide only materials, equipment, or supplies to a contractor or subcontractor.

'SPECIAL EXCEPTION':

A bidder may list 'Special Exception' in place of a subcontractor when the bidder intends to obtain a subcontractor to perform the work at a later date because the bidder was unable to obtain a qualified or reasonable bid under the provisions of U.C.A. Section 63A-5-208(4). The bidder shall insert the term 'Special Exception' for that category of work, and shall provide documentation with the subcontractor list describing the bidder's efforts to obtain a bid of a qualified subcontractor at a reasonable cost and why the bidder was unable to obtain a qualified subcontractor bid. The Director must find that the bidder complied in good faith with State law requirements for any 'Special Exception' designation, in order for the bid to be considered. If awarded the contract, the Director shall supervise the bidder's efforts to obtain a qualified subcontractor bid. The amount of the awarded contract may not be adjusted to reflect the actual amount of the subcontractor's bid. Any listing of 'Special Exception' on the sublist form shall also include amount allocated for that work.

GROUND FOR DISQUALIFICATION:

The Director may not consider any bid submitted by a bidder if the bidder fails to submit a subcontractor list meeting the requirements of State law. Director may withhold awarding the contract to a particular bidder if one or more of the proposed subcontractors are considered by the Director to be unqualified to do the Work or for

INSTRUCTIONS AND SUBCONTRACTORS LIST FORM
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such other reason in the best interest of the State of Utah. Notwithstanding any other provision in these instructions, if there is a good faith error on the sublist form, at the sole discretion of the Director, the Director may provide notice to the contractor and the contractor shall have 24 hours to submit the correction to the Director. If such correction is submitted timely, then the sublist requirements shall be considered met.

CHANGES OF SUBCONTRACTORS SPECIFICALLY IDENTIFIED ON SUBLIST FORM:

Subsequent to twenty-four hours after the bid opening, the contractor may change its listed subcontractors only after receiving written permission from the Director based on complying with all of the following criteria.

- (1) The contractor has established in writing that the change is in the best interest of the State and that the contractor establishes an appropriate reason for the change, which may include, but not is not limited to, the following reasons: the original subcontractor has failed to perform, or is not qualified or capable of performing, and/or the subcontractor has requested in writing to be released.
- (2) The circumstances related to the request for the change do not indicate any bad faith in the original listing of the subcontractors.
- (3) Any requirement set forth by the Director to ensure that the process used to select a new subcontractor does not give rise to bid shopping.
- (4) Any increase in the cost of the subject subcontractor work is borne by the contractor.
- (5) Any decrease in the cost of the subject subcontractor work shall result in a deductive change order being issued for the contract for such decreased amount.
- (6) The Director will give substantial weight to whether the subcontractor has consented in writing to being removed unless the Contractor establishes that the subcontractor is not qualified for the work.

EXAMPLE:

Example of a list where there are only four subcontractors:

TYPE OF WORK	SUBCONTRACTOR, “SELF” OR “SPECIAL EXCEPTION”	SUBCONTRACTOR BID AMOUNT	CONTRACTOR LICENSE #
ELECTRICAL	ABCD Electric Inc.	\$350,000.00	123456789000
LANDSCAPING	“Self” *	\$300,000.00	123456789000
CONCRETE (ALTERNATE #1)	XYZ Concrete Inc	\$298,000.00	987654321000
MECHANICAL	“Special Exception” (attach documentation)	Fixed at: \$350,000.00	(TO BE PROVIDED AFTER OBTAINING SUBCONTRACTOR)

* Bidders may list “self”, but it is not required.

**PURSUANT TO STATE LAW - SUBCONTRACTOR BID AMOUNTS CONTAINED IN THIS
SUBCONTRACTOR LIST SHALL NOT BE DISCLOSED UNTIL THE CONTRACT HAS BEEN AWARDED.**

**SUBCONTRACTORS LIST**

FAX TO 801-538-3677

PROJECT TITLE: _____

Caution: You must read and comply fully with instructions.

TYPE OF WORK	SUBCONTRACTOR, "SELF" OR "SPECIAL EXCEPTION"	SUBCONTRACTOR BID AMOUNT	CONT. LICENSE #

We certify that:

1. This list includes all subcontractors as required by the instructions, including those related to the base bid as well as any alternates.
2. We have listed "Self" or "Special Exception" in accordance with the instructions.
3. All subcontractors are appropriately licensed as required by State law.

FIRM: _____

DATE: _____

SIGNED BY: _____

NOTICE: FAILURE TO SUBMIT THIS FORM, PROPERLY COMPLETED AND SIGNED, AS REQUIRED IN THESE CONTRACT DOCUMENTS, SHALL BE GROUNDS FOR OWNER'S REFUSAL TO ENTER INTO A WRITTEN CONTRACT WITH BIDDER. ACTION MAY BE TAKEN AGAINST BIDDERS BID BOND AS DEEMED APPROPRIATE BY OWNER. ATTACH A SECOND PAGE IF NECESSARY.

CONTRACTOR'S AGREEMENT

FOR:

THIS CONTRACTOR'S AGREEMENT, made and entered into this ____ day of _____, 20__, by and between the DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT, hereinafter referred to as "DFCM", and _____, incorporated in the State of _____ and authorized to do business in the State of Utah, hereinafter referred to as "Contractor", whose address is _____.

WITNESSETH: WHEREAS, DFCM intends to have Work performed at _____.

WHEREAS, Contractor agrees to perform the Work for the sum stated herein.

NOW, THEREFORE, DFCM and Contractor for the consideration provided in this Contractor's Agreement, agree as follows:

ARTICLE 1. SCOPE OF WORK. The Work to be performed shall be in accordance with the Contract Documents prepared by _____ and entitled "_____"

The DFCM General Conditions ("General Conditions") dated May 25, 2005 and Supplemental General Conditions dated May 5, 2008 ("also referred to as General Conditions") on file at the office of DFCM and available on the DFCM website, are hereby incorporated by reference as part of this Agreement and are included in the specifications for this Project. All terms used in this Contractor's Agreement shall be as defined in the Contract Documents, and in particular, the General Conditions.

The Contractor Agrees to furnish labor, materials and equipment to complete the Work as required in the Contract Documents which are hereby incorporated by reference. It is understood and agreed by the parties hereto that all Work shall be performed as required in the Contract Documents and shall be subject to inspection and approval of DFCM or its authorized representative. The relationship of the Contractor to the DFCM hereunder is that of an independent Contractor.

ARTICLE 2. CONTRACT SUM. The DFCM agrees to pay and the Contractor agrees to accept in full performance of this Contractor's Agreement, the sum of _____ DOLLARS AND NO CENTS (\$_____.00), which is the base bid, and which sum also includes the cost of a 100% Performance Bond and a 100%

CONTRACTOR'S AGREEMENT
PAGE NO. 2

Payment Bond as well as all insurance requirements of the Contractor. Said bonds have already been posted by the Contractor pursuant to State law. The required proof of insurance certificates have been delivered to DFCM in accordance with the General Conditions before the execution of this Contractor's Agreement.

ARTICLE 3. TIME OF COMPLETION AND DELAY REMEDY. The Work shall be Substantially Complete by _____. Contractor agrees to pay liquidated damages in the amount of \$_____ per day for each day after expiration of the Contract Time until the Contractor achieves Substantial Completion in accordance with the Contract Documents, if Contractor's delay makes the damages applicable. The provision for liquidated damages is: (a) to compensate the DFCM for delay only; (b) is provided for herein because actual damages can not be readily ascertained at the time of execution of this Contractor's Agreement; (c) is not a penalty; and (d) shall not prevent the DFCM from maintaining Claims for other non-delay damages, such as costs to complete or remedy defective Work.

No action shall be maintained by the Contractor, including its or Subcontractor or suppliers at any tier, against the DFCM or State of Utah for damages or other claims due to losses attributable to hindrances or delays from any cause whatsoever, including acts and omissions of the DFCM or its officers, employees or agents, except as expressly provided in the General Conditions. The Contractor may receive a written extension of time, signed by the DFCM, in which to complete the Work under this Contractor's Agreement in accordance with the General Conditions.

ARTICLE 4. CONTRACT DOCUMENTS. The Contract Documents consist of this Contractor's Agreement, the Conditions of the Contract (DFCM General Conditions, Supplementary and other Conditions), the Drawings, Specifications, Addenda and Modifications. The Contract Documents shall also include the bidding documents, including the Invitation to Bid, Instructions to Bidders/ Proposers and the Bid/Proposal, to the extent not in conflict therewith and other documents and oral presentations that are documented as an attachment to the contract.

All such documents are hereby incorporated by reference herein. Any reference in this Contractor's Agreement to certain provisions of the Contract Documents shall in no way be construed as to lessen the importance or applicability of any other provisions of the Contract Documents.

ARTICLE 5. PAYMENT. The DFCM agrees to pay the Contractor from time to time as the Work progresses, but not more than once each month after the date of Notice to Proceed, and only upon Certificate of the A/E for Work performed during the preceding calendar month, ninety-five percent (95%) of the value of the labor performed and ninety-five percent (95%) of the value of materials furnished in place or on the site. The Contractor agrees to furnish to the DFCM invoices for materials purchased and on the site but not installed, for which the Contractor requests payment and agrees to

safeguard and protect such equipment or materials and is responsible for safekeeping thereof and if such be stolen, lost or destroyed, to replace same.

Such evidence of labor performed and materials furnished as the DFCM may reasonably require shall be supplied by the Contractor at the time of request for Certificate of Payment on account. Materials for which payment has been made cannot be removed from the job site without DFCM's written approval. Five percent (5%) of the earned amount shall be retained from each monthly payment. The retainage, including any additional retainage imposed and the release of any retainage, shall be in accordance with UCA 13-8-5 as amended. Contractor shall also comply with the requirements of UCA 13-8-5, including restrictions of retainage regarding subcontractors and the distribution of interest earned on the retention proceeds. The DFCM shall not be responsible for enforcing the Contractor's obligations under State law in fulfilling the retention law requirements with subcontractors at any tier.

ARTICLE 6. INDEBTEDNESS. Before final payment is made, the Contractor must submit evidence satisfactory to the DFCM that all payrolls, materials bills, subcontracts at any tier and outstanding indebtedness in connection with the Work have been properly paid. Final Payment will be made after receipt of said evidence, final acceptance of the Work by the DFCM as well as compliance with the applicable provisions of the General Conditions.

Contractor shall respond immediately to any inquiry in writing by DFCM as to any concern of financial responsibility and DFCM reserves the right to request any waivers, releases or bonds from Contractor in regard to any rights of Subcontractors (including suppliers) at any tier or any third parties prior to any payment by DFCM to Contractor.

ARTICLE 7. ADDITIONAL WORK. It is understood and agreed by the parties hereto that no money will be paid to the Contractor for additional labor or materials furnished unless a new contract in writing or a Modification hereof in accordance with the General Conditions and the Contract Documents for such additional labor or materials has been executed. The DFCM specifically reserves the right to modify or amend this Contractor's Agreement and the total sum due hereunder either by enlarging or restricting the scope of the Work.

ARTICLE 8. INSPECTIONS. The Work shall be inspected for acceptance in accordance with the General Conditions.

ARTICLE 9. DISPUTES. Any dispute, PRE or Claim between the parties shall be subject to the provisions of Article 7 of the General Conditions. DFCM reserves all rights to pursue its rights and remedies as provided in the General Conditions.

ARTICLE 10. TERMINATION, SUSPENSION OR ABANDONMENT. This Contractor's Agreement may be terminated, suspended or abandoned in accordance with the General Conditions.

ARTICLE 11. DFCM'S RIGHT TO WITHHOLD CERTAIN AMOUNT AND MAKE USE THEREOF. The DFCM may withhold from payment to the Contractor such amount as, in DFCM's judgment, may be necessary to pay just claims against the Contractor or Subcontractor at any tier for labor and services rendered and materials furnished in and about the Work. The DFCM may apply such withheld amounts for the payment of such claims in DFCM's discretion. In so doing, the DFCM shall be deemed the agent of Contractor and payment so made by the DFCM shall be considered as payment made under this Contractor's Agreement by the DFCM to the Contractor. DFCM shall not be liable to the Contractor for any such payment made in good faith. Such withholdings and payments may be made without prior approval of the Contractor and may be also be prior to any determination as a result of any dispute, PRE, Claim or litigation.

ARTICLE 12. INDEMNIFICATION. The Contractor shall comply with the indemnification provisions of the General Conditions.

ARTICLE 13. SUCCESSORS AND ASSIGNMENT OF CONTRACT. The DFCM and Contractor, respectively bind themselves, their partners, successors, assigns and legal representatives to the other party to this Agreement, and to partners, successors, assigns and legal representatives of such other party with respect to all covenants, provisions, rights and responsibilities of this Contractor's Agreement. The Contractor shall not assign this Contractor's Agreement without the prior written consent of the DFCM, nor shall the Contractor assign any moneys due or to become due as well as any rights under this Contractor's Agreement, without prior written consent of the DFCM.

ARTICLE 14. RELATIONSHIP OF THE PARTIES. The Contractor accepts the relationship of trust and confidence established by this Contractor's Agreement and covenants with the DFCM to cooperate with the DFCM and A/E and use the Contractor's best skill, efforts and judgment in furthering the interest of the DFCM; to furnish efficient business administration and supervision; to make best efforts to furnish at all times an adequate supply of workers and materials; and to perform the Work in the best and most expeditious and economic manner consistent with the interests of the DFCM.

ARTICLE 15. AUTHORITY TO EXECUTE AND PERFORM AGREEMENT. Contractor and DFCM each represent that the execution of this Contractor's Agreement and the performance thereunder is within their respective duly authorized powers.

ARTICLE 16. ATTORNEY FEES AND COSTS. Except as otherwise provided in the dispute resolution provisions of the General Conditions, the prevailing party shall be entitled to reasonable attorney fees and costs incurred in any action in the District Court and/or appellate body to enforce this Contractor's Agreement or recover damages or any other action as a result of a breach thereof.

CONTRACTOR'S AGREEMENT
PAGE NO. 5

IN WITNESS WHEREOF, the parties hereto have executed this Contractor's Agreement on the day and year stated hereinabove.

CONTRACTOR: _____

Signature Date

Title: _____

State of _____)
_____)
County of _____)

Please type/print name clearly

On this ____ day of _____, 20____, personally appeared before me, _____, whose identity is personally known to me (or proved to me on the basis of satisfactory evidence) and who by me duly sworn (or affirmed), did say that he (she) is the _____ (title or office) of the firm and that said document was signed by him (her) in behalf of said firm.

(SEAL)

Notary Public

My Commission Expires _____

APPROVED AS TO AVAILABILITY
OF FUNDS:

David D. Williams, Jr. Date
DFCM Administrative Services Director

**DIVISION OF FACILITIES
CONSTRUCTION AND MANAGEMENT**

Lynn A. Hinrichs Date
Assistant Director Construction Management

APPROVED AS TO FORM:
ATTORNEY GENERAL
May 5, 2008
By: Alan S. Bachman
Asst Attorney General

APPROVED FOR EXPENDITURE:

Division of Finance Date

PERFORMANCE BOND

(Title 63, Chapter 56, U. C. A. 1953, as Amended)

That _____ hereinafter referred to as the "Principal" and _____, a corporation organized and existing under the laws of the State of _____, with its principal office in the City of _____ and authorized to transact business in this State and U. S. Department of the Treasury Listed (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); hereinafter referred to as the "Surety," are held and firmly bound unto the State of Utah, hereinafter referred to as the "Obligee," in the amount of _____ DOLLARS (\$ _____) for the payment whereof, the said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written Contract with the Obligee, dated the _____ day of _____, 20____, to construct _____ in the County of _____, State of Utah, Project No. _____, for the approximate sum of _____ Dollars (\$ _____), which Contract is hereby incorporated by reference herein.

NOW, THEREFORE, the condition of this obligation is such that if the said Principal shall faithfully perform the Contract in accordance with the Contract Documents including, but not limited to, the Plans, Specifications and conditions thereof, the one year performance warranty, and the terms of the Contract as said Contract may be subject to Modifications or changes, then this obligation shall be void; otherwise it shall remain in full force and effect.

No right of action shall accrue on this bond to or for the use of any person or corporation other than the state named herein or the heirs, executors, administrators or successors of the Owner.

The parties agree that the dispute provisions provided in the Contract Documents apply and shall constitute the sole dispute procedures of the parties.

PROVIDED, HOWEVER, that this Bond is executed pursuant to the Provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this _____ day of _____, 20____.

WITNESS OR ATTESTATION:

PRINCIPAL:

By: _____ (Seal)

Title: _____

WITNESS OR ATTESTATION:

SURETY:

By: _____ Attorney-in-Fact (Seal)

STATE OF _____)
) ss.
COUNTY OF _____)

On this _____ day of _____, 20____, personally appeared before me _____, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney in-fact of the above-named Surety Company and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this _____ day of _____, 20____.

My commission expires: _____

Resides at: _____

NOTARY PUBLIC

Agency: _____
Agent: _____
Address: _____
Phone: _____

Approved As To Form: May 25, 2005
By Alan S. Bachman, Asst Attorney General

PAYMENT BOND

(Title 63, Chapter 56, U. C. A. 1953, as Amended)

KNOW ALL PERSONS BY THESE PRESENTS:

That _____ hereinafter referred to as the "Principal," and _____, a corporation organized and existing under the laws of the State of _____ authorized to do business in this State and U. S. Department of the Treasury Listed (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); with its principal office in the City of _____, hereinafter referred to as the "Surety," are held and firmly bound unto the State of Utah hereinafter referred to as the "Obligee," in the amount of _____ Dollars (\$ _____) for the payment whereof, the said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written Contract with the Obligee, dated the _____ day of _____, 20____, to construct _____ in the County of _____, State of Utah, Project No. _____ for the approximate sum of _____ Dollars (\$ _____), which contract is hereby incorporated by reference herein.

NOW, THEREFORE, the condition of this obligation is such that if the said Principal shall pay all claimants supplying labor or materials to Principal or Principal's Subcontractors in compliance with the provisions of Title 63, Chapter 56, of Utah Code Annotated, 1953, as amended, and in the prosecution of the Work provided for in said Contract, then, this obligation shall be void; otherwise it shall remain in full force and effect.

That said Surety to this Bond, for value received, hereby stipulates and agrees that no changes, extensions of time, alterations or additions to the terms of the Contract or to the Work to be performed thereunder, or the specifications or drawings accompanying same shall in any way affect its obligation on this Bond, and does hereby waive notice of any such changes, extensions of time, alterations or additions to the terms of the Contract or to the Work or to the specifications or drawings and agrees that they shall become part of the Contract Documents.

PROVIDED, HOWEVER, that this Bond is executed pursuant to the provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this _____ day of _____, 20____.

WITNESS OR ATTESTATION:

PRINCIPAL:

By: _____

(Seal)

Title: _____

WITNESS OR ATTESTATION:

SURETY:

By: _____

Attorney-in-Fact (Seal)

STATE OF _____)
) ss.

COUNTY OF _____)

On this _____ day of _____, 20____, personally appeared before me _____, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney-in-fact of the above-named Surety Company, and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this _____ day of _____, 20____.

My commission expires: _____

Resides at: _____

NOTARY PUBLIC

Agency: _____
Agent: _____
Address: _____
Phone: _____

Approved As To Form: May 25, 2005
By Alan S. Bachman, Asst Attorney General

**CERTIFICATE OF SUBSTANTIAL COMPLETION**

PROJECT _____ PROJECT NO: _____

AGENCY/INSTITUTION _____

AREA ACCEPTED _____

The Work performed under the subject Contract has been reviewed on this date and found to be Substantially Completed as defined in the General Conditions; including that the construction is sufficiently completed in accordance with the Contract Documents, as modified by any change orders agreed to by the parties, so that the State of Utah can occupy the Project or specified area of the Project for the use for which it is intended.

The DFCM - (Owner) accepts the Project or specified area of the Project as Substantially Complete and will assume full possession of the Project or specified area of the Project at _____ (time) on _____ (date).

The DFCM accepts the Project for occupancy and agrees to assume full responsibility for maintenance and operation, including utilities and insurance, of the Project subject to the itemized responsibilities and/or exceptions noted below:

The Owner acknowledges receipt of the following closeout and transition materials:

As-built Drawings

O & M Manuals

Warranty Documents

Completion of Training
Requirements

A list of items to be completed or corrected (Punch List) is attached hereto. The failure to include an item on it does not alter the responsibility of the Contractor to complete all the Work in accordance with the Contract Documents, including authorized changes thereof. The amount of _____ (Twice the value of the punch list work) shall be retained to assure the completion of the punch list work.

The Contractor shall complete or correct the Work on the list of (Punch List) items appended hereto within _____ calendar days from the above date of issuance of this Certificate. The amount withheld pending completion of the list of items noted and agreed to shall be: \$ _____. If the list of items is not completed within the time allotted the Owner has the right to be compensated for the delays and/or complete the work with the help of independent contractor at the expense of the retained project funds. If the retained project funds are insufficient to cover the delay/completion damages, the Owner shall be promptly reimbursed for the balance of the funds needed to compensate the Owner.

CONTRACTOR (include name of firm) by: _____
(Signature) DATE

A/E (include name of firm) by: _____
(Signature) DATE

USING INSTITUTION OR AGENCY by: _____
(Signature) DATE

DFCM (Owner) by: _____
(Signature) DATE

**General Contractor Performance Rating Form**

Project Name:		DFCM Project#	
Contractor: (ABC Construction, John Doe, 111-111-1111)	A/E: (ABC Architects, Jane Doe, 222-222-2222)	Original Contract Amount:	Final Contract Amount:
DFCM Project Manager:		Contract Date:	
Completion Date:		Date of Rating:	

Rating Guideline	QUALITY OF PRODUCT OR SERVICES	COST CONTROL	TIMELINESS OF PERFORMANCE	BUSINESS RELATIONS
5-Exceptional	Contractor has demonstrated an exceptional performance level in any of the above four categories that justifies adding a point to the score. Contractor performance clearly exceeds the performance levels described as "Very Good"			
4-Very Good	Contractor is in compliance with contract requirements and/or delivers quality product/service.	Contractor is effective in managing costs and submits current, accurate, and complete billings	Contractor is effective in meeting milestones and delivery schedule	Response to inquiries, technical/service/administrative issues is effective
3-Satisfactory	Minor inefficiencies/errors have been identified	Contractor is usually effective in managing cost	Contractor is usually effective in meeting milestones and delivery schedules	Response to inquires technical/service/administrative issues is somewhat effective
2-Marginal	Major problems have been encountered	Contractor is having major difficulty managing cost effectively	Contractor is having major difficulty meeting milestones and delivery schedule	Response to inquiries, technical/service/administrative issues is marginally effective
1-Unsatisfactory	Contractor is not in compliance and is jeopardizing achievement of contract objectives	Contractor is unable to manage costs effectively	Contractor delays are jeopardizing performance of contract objectives	Response to inquiries, technical/service/administrative issues is not effective

1. Rate Contractors quality of workmanship, management of sub contractor performance, project cleanliness, organization and safety requirement.	Score
<u>Agency Comments:</u>	
<u>A & E Comments:</u>	
<u>DFCM Project Manager Comments:</u>	

2. Rate Contractor administration of project costs, change orders and financial management of the project budget.	Score
<u>Agency Comments:</u>	
<u>A & E Comments:</u>	
<u>DFCM Project Manager Comments:</u>	

3. Rate Contractor's performance and adherence to Project Schedule, delay procedures and requirements of substantial completion, inspection and punch-list performance.	Score
<u>Agency Comments:</u>	
<u>A & E Comments:</u>	
<u>DFCM Project Manager Comments:</u>	

4. Evaluate performance of contractor management team including project manager, engineer and superintendent also include in the rating team's ability to work well with owner, user agency and consultants.	Score
<u>Agency Comments:</u>	
<u>A & E Comments:</u>	
<u>DFCM Project Manager Comments:</u>	

5. Rate success of Contractor's management plan, completion of the plans mitigation of project risks and performance of value engineering concepts.	Score
<u>Agency Comments:</u>	
<u>A & E Comments:</u>	
<u>DFCM Project Manager Comments:</u>	

Signed by:	Date:	Mean Score
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Additional Comments:

Office of Education UORS Alternate Data Center Upgrade

DFCM PROJECT #08230200



State of Utah—Department of Administrative Services

DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT

4110 State Office Building / Salt Lake City, Utah 84114 / 538-3018

SPECIFICATIONS

PREPARED BY

**WHW ENGINEERING INC.
8619 SOUTH SANDY PARKWAY, SUITE 101
SANDY, UTAH 84070
PHONE: (801) 466-4021
FAX: (801) 466-8536**

June 2008

WHW Engineering Project #08008

DIVISION 1 - GENERAL REQUIREMENTS

01000 GENERAL REQUIREMENTS
01100 SUMMARY OF WORK
01140 WORK RESTRICTIONS
01250 CONTRACT MODIFICATIONS PROCEDURES
01290 PAYMENT PROCEDURES
01310 PROJECT MANAGEMENT AND COORDINATION
01320 CONSTRUCTION PROGRESS DOCUMENTATION
01330 SUBMITTAL PROCEDURES
01500 TEMPORARY FACILITIES AND CONTROLS
01600 PRODUCT REQUIREMENTS
01700 EXECUTION REQUIREMENTS
01731 CUTTING AND PATCHING
01732 SELECTIVE DEMOLITION
01770 CLOSEOUT PROCEDURES

DIVISION 2 - SITE WORK

02230 SITE CLEARING
02231 TREE PROTECTION AND TRIMMING
02260 EXCAVATION SUPPORT AND PROTECTION
02300 EARTHWORK
02741 ASPHALT PAVING
02751 CEMENT CONCRETE PAVEMENT
02821 CHAIN LINK FENCE

DIVISION 3 - CONCRETE

03301 CAST-IN PLACE CONCRETE (LIMITED APPLICATIONS)

DIVISION 4 - MASONRY

04810 UNIT MASONRY ASSEMBLIES

DIVISION 5 - METALS

05400 COLD-FORMED METAL FRAMING

DIVISION 6 - WOOD AND PLASTICS

06100 ROUGH CARPENTRY

DIVISION 8 - DOORS AND WINDOWS

08712 DOOR HARDWARE

DIVISION 9 - FINISHES

09260 GYPSUM BOARD ASSEMBLIES

09511 ACOUSTICAL TILE CEILING
09651 RESILIENT FLOOR TILE
09680 CARPET
09912 PAINTING

DIVISION 15 - MECHANICAL

15010 GENERAL REQUIREMENTS
15050 BASIC MECHANICAL MATERIALS & METHODS
15075 MECHANICAL IDENTIFICATION
15080 HVAC AND PLUMBING INSULATION
15140 DOMESTIC WATER PIPING
15151 CONDENSATE DRAIN PIPING
15734 COMPUTER ROOM AIR CONDITIONING UNITS
15815 METAL DUCTS
15855 DIFFUSERS REGISTER AND GRILLES
15900 HVAC INSTRUMENTATION AND CONTROLS
15950 TESTING ADJUSTING AND BALANCING

DIVISION 16 - ELECTRICAL

16050 BASIC ELECTRICAL MATERIALS AND METHODS
16120 WIRES AND CABLES
16130 RACEWAYS
16140 SWITCHES AND RECEPTACLES
16470 PANEL BOARDS
16478 TRANSIENT VOLTAGE SURGE SUPPRESSORS
16500 LIGHTING
16530 LIGHTING CONTROL
16550 OCCUPANCY SENSED LIGHTING CONTROL
16621 ENGINE GENERATORS
16623 GENERATOR CONTROL BOARDS
16625 AUTOMATIC TRANSFER SWITCHES
16740 TELEPHONE/DATA SYSTEMS WIRING
16790 ACCESS CONTROLS

DIVISION 1 - GENERAL REQUIREMENTS

01000 GENERAL REQUIREMENTS
01100 SUMMARY OF WORK
01140 WORK RESTRICTIONS
01250 CONTRACT MODIFICATIONS PROCEDURES
01290 PAYMENT PROCEDURES
01310 PROJECT MANAGEMENT AND COORDINATION
01320 CONSTRUCTION PROGRESS DOCUMENTATION
01330 SUBMITTAL PROCEDURES
01500 TEMPORARY FACILITIES AND CONTROLS
01600 PRODUCT REQUIREMENTS
01700 EXECUTION REQUIREMENTS
01731 CUTTING AND PATCHING
01732 SELECTIVE DEMOLITION
01770 CLOSEOUT PROCEDURES

SECTION 01000 - GENERAL REQUIREMENTS

PART 1 - GENERAL

- 1.1 This project shall be a standard DFCM single prime contract. DFCM General Conditions and design and construction standards shall apply. DFCM documents are available for download at www.dfcm.utah.gov

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01000

SECTION 01100 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Work covered by the Contract Documents.
2. Type of the Contract.
3. Work phases.
4. Work under other contracts.
5. Products ordered in advance.
6. Owner-furnished products.
7. Use of premises.
8. Owner's occupancy requirements.
9. Work restrictions.
10. Specification formats and conventions.

- B. Related Sections include the following:

1. Division 1 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification: Judy Anne Buffmire, Office of Education UORS: Alternate Data Center Upgrade, DFCM Project No. 08230200.

1. Project Location: Salt Lake city, 1595 West 500 South .

- B. Owner: State of Utah, Department of Facilities and Construction Management.

1. Owner's Representative: Jim Russell, Mike Wollenzien

- C. Architect: Method Studio, contact: Steven Duncan, Project Manager. Alt. Contact: Joe Smith

- D. Design Project Lead: Win Packer, WHW Engineers.

- E. The Architectural Scope of Work consists of the following:

1. **Rooms 144 & 143:** The Work includes, partial demolition of conference room floors to allow for data/power installation, as well as removal of existing carpeting and rubber base within these rooms. Construction includes concrete infill following data/power installation to repair existing concrete slab, as well as installation of new rubber base and carpeting.
2. **Data Rooms 117 & 116:** The Work includes, removal of metal stud wall between two rooms, rubber base, and carpet. Also remove door and frame for room 116. Infill with metal studs & finish wall to match existing adjacent surfaces. Remove ceiling tiles in room 116 and salvage for reinstallation. Remove ceiling grid of room 116 and install new grid this room, to align and match with grid of room 117. Relocate light fixtures as shown in plans. Install new rubber base and VCT flooring both rooms.
3. **Backup Generator:** Sawcut existing asphalt pavement in area shown on plan to allow for installation of footings/slab, & enclosure walls for new generator. Protect shrub from damage. Sawcut/trench as necessary to run line from building to generator (see electrical). Install CMU block walls as sound barrier/enclosure around generator. Provide chain-link gates & fencing to provide access to generator. Patch/repair curb, asphalt, sidewalk, landscaping to provide smooth surface between new and old.
4. **Refer to drawings for full scope of work.**

1.4 TYPE OF CONTRACT

- A. Project will be constructed under a single prime contract.

1.5 USE OF PREMISES

- A. General: Contractor shall have limited use of premises for construction operations as indicated on Drawings by the Contract limits.

1.6 OWNER'S OCCUPANCY REQUIREMENTS

- A. Full Owner Occupancy: Owner will occupy site and building during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits, unless otherwise indicated.
 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
 2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

1.7 WORK RESTRICTIONS

- A. On-Site Work Hours: Work shall be generally performed inside the existing building during normal business working hours.
- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner

1.8 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 16-division format and CSI/CSC's "MasterFormat" numbering system.
 - 1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
 - 2. Division 1: Sections in Division 1 govern the execution of the Work of all Sections in the Specifications.
- B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
 - 2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
 - a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

END OF SECTION 01100

SECTION 01140 - WORK RESTRICTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 USE OF PREMISES

- A. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of site beyond areas in which the Work is indicated. Refer to Civil, Architectural and Electrical site plans for utility and site work required to provide uninterrupted service and access to adjacent facilities and areas.
 - 1. Limits: Confine constructions operations to within the Contract Limit line.
 - 2. Owner Occupancy: Allow for Owner and public access and use of College campus.
 - 3. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, the public and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.3 OCCUPANCY REQUIREMENTS

- A. Full Owner Occupancy: Owner will occupy adjacent areas around site and existing building during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations.
- B. Partial Owner Occupancy: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.
 - 1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.
 - 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
 - 3. Before partial Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will provide, operate, and maintain mechanical and electrical systems serving occupied portions of building.

4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01140

SECTION 01250 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Sections include the following:
 - 1. Division 1 Section "Unit Prices" for administrative requirements for using unit prices.
 - 2. Division 1 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions, called a field order, authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or a maximum of 14 days after receipt of Proposal Request, submit a quotation estimating cost adjustments, if any, to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products and labor required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and

finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

- B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to the Architect.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 4. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - 5. Comply with requirements in Division 1 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.
- C. Proposal Request Form: Use AIA Document G709 for Proposal Requests.
- D. Proposal Request Form: For Change Order proposals, use forms provided by Owner. Sample copies are included herein.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, or request for equitable adjustment, Architect will issue a Change Order for signatures of Owner and Contractor on Owners change order form, included is a copy or as part of the Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01250

SECTION 01290 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Sections include the following:
 - 1. Division 1 Section "Unit Prices" for administrative requirements governing use of unit prices.
 - 2. Division 1 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 3. Division 1 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
 - 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with Continuation Sheets.
 - b. Submittals Schedule.
 - 2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
 - 3. Subschedules: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values correlated with each phase of payment.

- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the Schedule of Values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect and Owners project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value.
 - 1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing if required.
6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Allowances: Provide a separate line item in the Schedule of Values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
8. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.

9. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Forms: AIA forms G702 and G703 shall be used for Contractor Application and Certificate for Payment forms.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
 2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Transmittal: Submit 3 signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt. One copy shall include waivers of lien and similar attachments if required.
 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
 1. Submit partial waivers on each item for amount requested, before deduction for retainage, on each item.
 2. When an application shows completion of an item, submit final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Waiver Delays: Submit each Application for Payment with Contractor's waiver of mechanic's lien for construction period covered by the application.

- a. Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 1. List of subcontractors.
 2. Schedule of Values.
 3. Contractor's Construction Schedule (preliminary if not final).
 4. Products list.
 5. Schedule of unit prices.
 6. Submittals Schedule (preliminary if not final).
 7. List of Contractor's staff assignments.
 8. List of Contractor's principal consultants.
 9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 10. Initial progress report.
 11. Report of preconstruction conference.
 12. Certificates of insurance and insurance policies.
 13. Performance and payment bonds.
 14. Data needed to acquire Owner's insurance.
 15. Initial settlement survey and damage report if required.
- I. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
 1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
 1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 6. AIA Document G707, "Consent of Surety to Final Payment."
 7. Evidence that claims have been settled.
 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

9. Final, liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01290

SECTION 01310 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General project coordination procedures.
 - 2. Conservation.
 - 3. Coordination Drawings.
 - 4. Administrative and supervisory personnel.
 - 5. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Construction Progress Documentation" for preparing and submitting the Contractor's Construction Schedule.
 - 2. Division 1 Section "Execution Requirements" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Division 1 Section "Closeout Procedures" for coordinating Contract closeout.

1.3 COORDINATION

- A. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.

- B. If necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's Construction Schedule.
 - 2. Preparation of the Schedule of Values.
 - 3. Installation and removal of temporary facilities and controls.
 - 4. Delivery and processing of submittals.
 - 5. Progress meetings.
 - 6. Preinstallation conferences.
 - 7. Project closeout activities.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work.

1.4 SUBMITTALS

- A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
 - 1. Indicate relationship of components shown on separate Shop Drawings.
 - 2. Indicate required installation sequences.
 - 3. Refer to Division 15 Section "Basic Mechanical Materials and Methods" and Division 16 Section "Basic Electrical Materials and Methods" for specific Coordination Drawing requirements for mechanical and electrical installations.
- B. Staff Names: Within 15 days of starting construction operations, submit a list of principal staff assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
 - 1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone.

1.5 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

- A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

- 1. Include special personnel required for coordination of operations with other contractors.

1.6 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

- 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 - 3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within 3 days of the meeting.

- B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.

- 1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; manufacturers; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing.
 - d. Designation of responsible personnel.
 - e. Procedures for processing field decisions and Change Orders.
 - f. Procedures for processing Applications for Payment.
 - g. Distribution of the Contract Documents.
 - h. Submittal procedures.
 - i. Preparation of Record Documents.
 - j. Use of the premises.
 - k. Responsibility for temporary facilities and controls.
 - l. Parking availability.
 - m. Office, work, and storage areas.
 - n. Equipment deliveries and priorities.
 - o. First aid.
 - p. Security.
 - q. Progress cleaning.
 - r. Working hours.

- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related Change Orders.
 - d. Purchases.
 - e. Deliveries.
 - f. Submittals.
 - g. Review of mockups.
 - h. Possible conflicts.
 - i. Compatibility problems.
 - j. Time schedules.
 - k. Weather limitations.
 - l. Manufacturer's written recommendations.
 - m. Warranty requirements.
 - n. Compatibility of materials.
 - o. Acceptability of substrates.
 - p. Temporary facilities and controls.
 - q. Space and access limitations.
 - r. Regulations of authorities having jurisdiction.
 - s. Testing and inspecting requirements.
 - t. Required performance results.
 - u. Protection of construction and personnel.
 3. Record significant conference discussions, agreements, and disagreements.
 4. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at bi-weekly intervals. Coordinate dates of meetings with preparation of payment requests.
1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule,

- in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
- b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Change Orders.
 - 14) Documentation of information for payment requests.
3. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.
- a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- E. Coordination Meetings: Conduct Project coordination meetings at bi-weekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
- 1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work
 - 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to Combined Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

- b. Schedule Updating: Revise Combined Contractor's Construction Schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Change Orders.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01310

SECTION 01320 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Contractor's Construction Schedule.
 - 2. Submittals Schedule.
 - 3. Daily construction reports.
 - 4. Field condition reports.
 - 5. Construction photographs.
- B. See Division 1 Section "Payment Procedures" for submitting the Schedule of Values.
- C. See Division 1 Section "Closeout Procedures" for submitting photographic negatives as Project Record Documents at Project closeout.
- D. Division1 "General Conditions."

1.2 DEFINITIONS

- A. Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- B. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
- C. Fragment: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.
- D. Major Area: A story of construction, a separate building, or a similar significant construction element.

1.3 SUBMITTALS

- A. Submittals Schedule: Submit three copies of schedule. Arrange the following information in a tabular format:
 - 1. Scheduled date for first submittal.
 - 2. Specification Section number and title.
 - 3. Submittal category (action or informational).

4. Name of subcontractor.
 5. Description of the Work covered.
 6. Scheduled date for Architect's final release or approval.
- B. Preliminary Network Diagram: Submit two printed copies, one a single sheet of reproducible media and one a print, large enough to show entire network for entire construction period.
- C. Contractor's Construction Schedule: Submit three printed copies of initial schedule, one a reproducible print and one a blue- or black-line print, large enough to show entire schedule for entire construction period.
- D. CPM Reports: Concurrent with CPM schedule, submit three printed copies of each of the following computer-generated reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float.
1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
 2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
 3. Total Float Report: List of all activities sorted in ascending order of total float.
- E. Daily Construction Reports: Submit three copies at weekly intervals.
- F. Field Condition Reports: Submit three copies at time of discovery of differing conditions.

1.4 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
1. Secure time commitments for performing critical elements of the Work from parties involved.
 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.
- C. Auxiliary Services: Cooperate with photographer and provide auxiliary services requested, including access to Project site and use of temporary facilities including temporary lighting.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

- A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
 - 1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
 - 2. Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than 30 days, unless specifically allowed by Architect.
 - 2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - 3. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
 - 4. Startup and Testing Time: Include not less than 10 days for startup and testing.
 - 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 - 1. Phasing: Arrange list of activities on schedule by phase.
 - 2. Work under More Than One Contract: Include a separate activity for each contract.
 - 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 - 4. Work Restrictions: Show the effect on the schedule of the following:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Use of premises restrictions.
 - e. Provisions for future construction.
 - f. Seasonal variations.

- g. Environmental control.
- 5. Work Stages: Indicate important stages of construction for each major portion of the Work.
- 6. Other Constraints: Coordination with Multiple Contracts.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice to Proceed. Base schedule on the Preliminary Construction Schedule and whatever updating and feedback was received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
 - 1. For construction activities that require 3 months or longer to complete, indicate an estimated completion percentage in **10** percent increments within time bar.

2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Preliminary Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's Construction Schedule using a CPM network analysis diagram.
 - 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for the Notice to Proceed.
 - 2. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 - 3. Use "one workday" as the unit of time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following:
 - a. Preparation and processing of submittals.
 - b. Purchase of materials.
 - c. Delivery.
 - d. Fabrication.
 - e. Installation.
 2. Processing: Process data to produce output data or a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 3. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- E. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Principal events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
 9. Average size of workforce.
- F. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.

2.5 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording events at Project site, including the following:
1. List of subcontractors.
 2. High and low temperatures and general weather conditions.

3. Accidents.
4. Stoppages, delays, shortages, and losses.
5. Meter readings and similar recordings.
6. Orders and requests of authorities having jurisdiction.
7. Services connected and disconnected.
8. Equipment or system tests and startups.

- B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare a detailed report. Submit with a request for information on CSI Form 13.2A. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate Actual Completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

3.2 CONSTRUCTION PHOTOGRAPHS

- A. Photographic: Medium: 2 ¼ Digital, Min. by 2-3/4 inches (60 by 70 mm).
- B. Date Stamp: Unless otherwise indicated, date and time stamp each photograph as it is being taken so stamp is integral to photograph.
- C. Periodic Construction Photographs: Take a minimum of four color photographs monthly, coinciding with cutoff date associated with each Application for Payment. Photographer shall select vantage points to best show status of construction and progress since last photographs were taken.

1. Field Office Prints: Retain one set of prints of periodic photographs in field office at Project site, available at all times for reference. Deliver one set of prints to Architect each month. Identify photographs the same for those submitted to Architect.

END OF SECTION 01320

SECTION 01330 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other miscellaneous submittals.
- B. Related Sections include the following:
 - 1. Division 1 Section "General Conditions" for submitting Applications for Payment.
 - 2. Division 1 Section "General Conditions" for submitting Coordination Drawings.
 - 3. Division 1 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.
 - 4. Division 1 Section "Quality Requirements" for submitting test and inspection reports and Delegated-Design Submittals.
 - 5. Division 1 Section "Closeout Procedures" for submitting warranties Project Record Documents and operation and maintenance manuals.
 - 6. Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 7. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Architect's and DFCM's Project Managers responsive action.
- B. Informational Submittals: Written information that does not require Architect's and DFCM's Project Managers responsive action. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

- A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- B. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
- C. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal.
 1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Concurrent Review: Where concurrent review of submittals by Architect's consultants, Owner, or other parties is required, allow 21 days for initial review of each submittal.
 3. If intermediate submittal is necessary, process it in same manner as initial submittal.
 4. Allow 10 days for processing each resubmittal.
 5. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.
- D. Identification: Place a permanent label or title block on each submittal for identification.
 1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide a space approximately 4 by 5 inches (100 by 125 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect and consulting engineer.
 3. Include the following information on label for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name and address of Contractor.
 - e. Name and address of subcontractor.
 - f. Name and address of supplier.
 - g. Name of manufacturer.
 - h. Unique identifier, including revision number.
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.
 - k. Other necessary identification.
- E. **Deviations: Highlight, encircle, or otherwise identify deviations from the Contract Documents on submittals.**

- F. Additional Copies: Unless additional copies are required for final submittal, and unless Architect or Construction Manager observes noncompliance with provisions of the Contract Documents, initial submittal may serve as final submittal.
1. Additional copies submitted for maintenance manuals will not be marked with action taken and will be returned.
- G. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than Contractor.
1. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements of the Contract Documents, including minor variations and limitations. Include the same label information as the related submittal.
 2. **Include Contractor's certification stating that information submitted complies with requirements of the Contract Documents.**
 3. Transmittal Form: Use AIA Document or G810 CSI Form 12.1A.
 4. Transmittal Form: Provide locations on form for the following information:
 - a. Project name.
 - b. Date.
 - c. Destination (To:).
 - d. Source (From:).
 - e. Names of subcontractor, manufacturer, and supplier.
 - f. Category and type of submittal.
 - g. Submittal purpose and description.
 - h. Submittal and transmittal distribution record.
 - i. Remarks.
 - j. Signature of transmitter.
- H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- I. Use for Construction: Use only final submittals with mark indicating action taken by Architect in connection with construction.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
1. Number of Copies: Submit copies of each submittal, as follows, unless otherwise indicated:

- a. Initial Submittal: Submit a preliminary single copy of each submittal where selection of options, color, pattern, texture, or similar characteristics is required. Architect will return submittal with options selected.
 - b. Final Submittal: Submit five copies, unless copies are required for operation and maintenance manuals. Architect will retain two copies; remainder will be returned. Mark up and retain one returned copy as a Project Record Document.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's written recommendations.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions.
 - d. Standard color charts.
 - e. Manufacturer's catalog cuts.
 - f. Wiring diagrams showing factory-installed wiring.
 - g. Printed performance curves.
 - h. Operational range diagrams.
 - i. Mill reports.
 - j. Standard product operating and maintenance manuals.
 - k. Compliance with recognized trade association standards.
 - l. Compliance with recognized testing agency standards.
 - m. Application of testing agency labels and seals.
 - n. Notation of coordination requirements.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
 1. Preparation: Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Shopwork manufacturing instructions.
 - g. Templates and patterns.
 - h. Schedules.
 - i. Design calculations.
 - j. Compliance with specified standards.
 - k. Notation of coordination requirements.
 - l. Notation of dimensions established by field measurement.
 2. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

3. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 40 inches (750 by 1000 mm).
 4. Number of Copies: Submit copies of each submittal, as follows:
 - a. Initial Submittal: Submit two blue- or black-line prints. Architect will return one print.
 - b. Final Submittal: Submit three blue- or black-line prints, unless prints are required for operation and maintenance manuals. Submit five prints where prints are required for operation and maintenance manuals. Architect will retain two prints; remainder will be returned.
- D. Coordination Drawings: Comply with requirements in Division 1 Section "Project Management and Coordination."
- E. Samples: Prepare physical units of materials or products, including the following:
1. Comply with requirements in Division 1 Section "Quality Requirements" for mockups.
 2. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 3. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from the same material to be used for the Work, cured and finished in manner specified, and physically identical with the product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 4. Preparation: Mount, display, or package Samples in manner specified to facilitate review of qualities indicated. Prepare Samples to match Architect's sample where so indicated. Attach label on unexposed side that includes the following:
 - a. Generic description of Sample.
 - b. Product name or name of manufacturer.
 - c. Sample source.
 5. Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, provide the following:
 - a. Size limitations.
 - b. Compliance with recognized standards.
 - c. Availability.
 - d. Delivery time.
 6. Submit Samples for review of kind, color, pattern, and texture for a final check of these characteristics with other elements and for a comparison of these characteristics between final submittal and actual component as delivered and installed.
 - a. If variation in color, pattern, texture, or other characteristic is inherent in the product represented by a Sample, submit at least three sets of paired units that show approximate limits of the variations.

- b. Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.
 - 7. Number of Samples for Initial Selection: Submit one full set[s] of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
 - 8. Number of Samples for Verification: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.
 - a. Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 9. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
- F. Product Schedule or List: Prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 - 1. Type of product. Include unique identifier for each product.
 - 2. Number and name of room or space.
 - 3. Location within room or space.
- G. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation."
- H. Application for Payment: Comply with requirements in Division 1 Section "Payment Procedures."
- I. Schedule of Values: Comply with requirements in Division 1 Section "Payment Procedures."
- J. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.

2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
 - 1. Number of Copies: Submit two copies of each submittal, unless otherwise indicated. Architect will not return copies.
 - 2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - 3. Test and Inspection Reports: Comply with requirements in Division 1 Section "Quality Requirements."
- B. Contractor's Construction Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation."
- C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- D. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements.
- E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements and, where required, is authorized for this specific Project.
- G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements. Include evidence of manufacturing experience where required.
- H. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements.
- I. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
- J. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements.
- K. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- L. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during

installation of product or after product is installed in its final location, for compliance with requirements.

- M. **Product Test Reports:** Prepare written reports indicating current product produced by manufacturer complies with requirements. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- N. **Maintenance Data:** Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements in Division 1 Section "
- O. **Design Data:** Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- P. **Manufacturer's Instructions:** Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
 - 1. Preparation of substrates.
 - 2. Required substrate tolerances.
 - 3. Sequence of installation or erection.
 - 4. Required installation tolerances.
 - 5. Required adjustments.
 - 6. Recommendations for cleaning and protection.
- Q. **Insurance Certificates and Bonds:** Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.
- R. **Construction Photographs:** Comply with requirements in Division 1 Section ".
- S. **Material Safety Data Sheets:** Submit information directly to Owner. If submitted to Architect, Architect will not review this information but will return it with no action taken.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. **Review each submittal and check for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.**
- B. **Approval Stamp:** Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date

of Contractor's approval, and **statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.**

3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken.
- C. Informational Submittals: Architect will review each submittal and will not return it, or will reject and return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- D. Submittals not required by the Contract Documents will not be reviewed and may be discarded.

END OF SECTION 01330

SECTION 01500 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection facilities.
 - 1. Contractor shall be permitted to tie into existing building for temporary power and heat. Contractor shall be responsible to manage use of utilities responsibly.
- B. Temporary utilities may include, but are not limited to, the following:
 - 1. Water service and distribution.
 - 2. Sanitary facilities, including toilets, wash facilities, and drinking-water facilities.
 - 3. Heating and cooling facilities.
 - 4. Electric power service.
 - 5. Lighting.
- C. Support facilities may include, but are not limited to, the following:
 - 1. Project identification and temporary signs.
 - 2. Waste disposal facilities.
 - 3. Field offices.
 - 4. Temporary stairs.
 - 5. Construction aids and miscellaneous services and facilities.
- D. Security and protection facilities include, but are not limited to, the following:
 - 1. Site enclosure fence.
 - 2. Security enclosure and lockup.
 - 3. Barricades, warning signs, and lights.
 - 4. Covered walkways.
 - 5. Temporary enclosures.
 - 6. Temporary partitions.
 - 7. Fire protection.

1.3 DEFINITIONS

- A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.4 USE CHARGES

- A. General: Cost or use charges for temporary facilities are not chargeable to Owner or Architect and shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:
 - 1. Owner's construction forces.
 - 2. Occupants of Project.
 - 3. Architect and Consultants
 - 4. Testing agencies.
 - 5. Personnel of authorities having jurisdiction.
- B. Water Service: Pay water service use charges, whether metered or otherwise, for water used by all entities engaged in construction activities at Project site.
- C. Electric Power Service: Pay electric power service use charges, whether metered or otherwise, for electricity used by all entities engaged in construction activities at Project site.

1.5 SUBMITTALS

- A. Temporary Utility Reports: Submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.
- B. Implementation and Termination Schedule: Within 15 days of date established for submittal of Contractor's Construction Schedule, submit a schedule indicating implementation and termination of each temporary utility.

1.6 QUALITY ASSURANCE

- A. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.
 - 1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.
 - 2. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.7 PROJECT CONDITIONS

- A. Temporary Utilities: At earliest feasible time, when acceptable to Owner, change over from use of temporary service to use of permanent service.
 - 1. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service

during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

- B. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:
1. Keep temporary services and facilities clean and neat.
 2. Relocate temporary services and facilities as required by progress of the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.
- B. Lumber and Plywood: Comply with requirements in Division 6 Section "Rough Carpentry."
- C. Gypsum Board: Minimum 1/2 inch (12.7 mm) thick by 48 inches (1219 mm) wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C 36.
- D. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively.
- E. Paint: Comply with requirements in Division 9 Section "Painting."
- F. Tarpaulins: Fire-resistive labeled with flame-spread rating of 15 or less.
- G. Water: Potable.

2.2 EQUIPMENT

- A. General: Provide equipment suitable for use intended.
1. Field Offices: Mobile units with lockable entrances, operable windows, and serviceable finishes; heated and air conditioned; on foundations adequate for normal loading.
- B. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.
1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.
- C. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.
- D. Drinking-Water Fixtures: tap-dispenser, or bottled-water drinking-water units, including paper cup supply.

1. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 to 55 deg F (7.2 to 12.7 deg C).
- E. Heating Equipment: Unless Owner authorizes use of permanent heating system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 2. Heating Units: Listed and labeled, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use for type of fuel being consumed.
- F. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.
- G. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.
- B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Engage appropriate local utility company to install temporary service or connect to existing service. Where utility company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company recommendations.
 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
 2. Provide adequate capacity at each stage of construction. Before temporary utility is available, provide trucked-in services.
 3. Obtain easements to bring temporary utilities to Project site where Owner's easements cannot be used for that purpose.
- B. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction until permanent water service is in use. Sterilize temporary water piping before use.

1. Provide rubber hoses as necessary to serve Project site.
 2. As soon as water is required at each level, extend service to form a temporary water- and fire-protection standpipe. Provide distribution piping. Space outlets so water can be reached with a 100-foot (30-m) hose. Provide one hose at each outlet.
 3. Where installations below an outlet might be damaged by spillage or leakage, provide a drip pan of suitable size to minimize water damage. Drain accumulated water promptly from pans.
- C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.
1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
 2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Provide separate facilities for male and female personnel.
 3. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel who handle materials that require wash up. Dispose of drainage properly. Supply cleaning compounds appropriate for each type of material handled.
 - a. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.
 4. Drinking-Water Facilities: Provide bottled-water, drinking-water units.
 - a. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 to 55 deg F (7.2 to 12.7 deg C).
 5. Locate toilets and drinking-water fixtures so personnel need not walk more than two stories vertically or 200 feet (60 m) horizontally to facilities.
- D. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed.
1. Maintain a minimum temperature of 50 deg F (10 deg C) in permanently enclosed portions of building for normal construction activities, and 65 deg F (18.3 deg C) for finishing activities and areas where finished Work has been installed.
- E. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- F. Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload-protected disconnecting means, automatic ground-fault interrupters, and main distribution switchgear.

1. Install electric power service underground, unless overhead service must be used.
 2. Install power distribution wiring overhead and rise vertically where least exposed to damage.
 3. Connect temporary service to Owner's existing power source, as directed by electric company officials.
- G. Electric Power Service: Use of Owner's existing electric power service will be permitted, as long as equipment is maintained in a condition acceptable to Owner.
- H. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment.
1. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
 2. Provide metal conduit, tubing, or metallic cable for wiring exposed to possible damage. Provide rigid steel conduits for wiring exposed on grades, floors, decks, or other traffic areas.
 3. Provide metal conduit enclosures or boxes for wiring devices.
 4. Provide 4-gang outlets, spaced so 100-foot (30-m) extension cord can reach each area for power hand tools and task lighting. Provide a separate 125-V ac, 20-A circuit for each outlet.
- I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations and traffic conditions.
1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 2. Provide one 100-W incandescent lamp per 500 sq. ft. (45 sq. m), uniformly distributed, for general lighting, or equivalent illumination.
 3. Provide one 100-W incandescent lamp every 50 feet (15 m) in traffic areas.
 4. Provide one 100-W incandescent lamp per story in stairways and ladder runs, located to illuminate each landing and flight.
 5. Install exterior-yard site lighting that will provide adequate illumination for construction operations, traffic conditions, and signage visibility when the Work is being performed.
 6. Install lighting for Project identification sign.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
1. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.
 2. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines. Comply with NFPA 241.
 3. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

- B. Project Identification and Temporary Signs: Prepare Project identification and other signs in sizes indicated. Install signs where indicated to inform public and persons seeking entrance to Project. Do not permit installation of unauthorized signs.
 - 1. Engage an experienced sign painter to apply graphics for Project identification signs. Comply with details indicated.
 - 2. Prepare temporary signs to provide directional information to construction personnel and visitors.
 - 3. Construct signs of exterior-type Grade B-B high-density concrete form overlay plywood in sizes and thicknesses indicated. Support on posts or framing of preservative-treated wood or steel.
 - 4. Paint sign panel and applied graphics with exterior-grade alkyd gloss enamel over exterior primer.
- C. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Containerize and clearly label hazardous, dangerous, or unsanitary waste materials separately from other waste. Comply with Division 1 Section "Execution Requirements" for progress cleaning requirements.
 - 1. If required by authorities having jurisdiction, provide separate containers, clearly labeled, for each type of waste material to be deposited.
 - 2. Develop a waste management plan for Work performed on Project. Indicate types of waste materials Project will produce and estimate quantities of each type. Provide detailed information for on-site waste storage and separation of recyclable materials. Provide information on destination of each type of waste material and means to be used to dispose of all waste materials.
- D. Janitorial Services: Provide janitorial services on a daily basis for temporary offices, first-aid stations, toilets, wash facilities, lunchrooms, and similar areas.
- E. Common-Use Field Office: Provide an insulated, weathertight, air-conditioned field office for use as a common facility by all personnel engaged in construction activities; of sufficient size to accommodate required office personnel and meetings of 10 persons at Project site. Keep office clean and orderly.
- F. Lifts and Hoists: Provide facilities for hoisting materials and personnel. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- G. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate. Cover finished, permanent stairs with protective covering of plywood or similar material so finishes will be undamaged at time of acceptance.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION (AS NEEDED)

- A. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from construction damage. Protect tree root systems from damage, flooding, and erosion.

- B. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
- C. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and public of possible hazard. Where appropriate and needed, provide lighting, including flashing red or amber lights.
 - 1. For safety barriers, sidewalk bridges, and similar uses, provide minimum ~~5/8-inch-~~ (16-mm-) thick exterior plywood.
- D. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
 - 2. Vertical Openings: Close openings of 25 sq. ft. (2.3 sq. m) or less with plywood or similar materials.
 - 3. Horizontal Openings: Close openings in floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.
 - 4. Install tarpaulins securely using fire-retardant-treated wood framing and other materials.
 - 5. Where temporary wood or plywood enclosure exceeds 100 sq. ft. (9.2 sq. m) in area, use fire-retardant-treated material for framing and main sheathing.
- E. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
 - 1. Construct dustproof partitions of not less than nominal 4-inch (100-mm) studs, 5/8-inch (16-mm) gypsum wallboard with joints taped on occupied side, and 1/2-inch (13-mm) fire-retardant plywood on construction side.
 - 2. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.
 - 3. Protect air-handling equipment.
 - 4. Weatherstrip openings.
- F. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
 - 1. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.
 - a. Field Offices: Class A stored-pressure water-type extinguishers.
 - b. Other Locations: Class ABC dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for exposures.
 - c. Locate fire extinguishers where convenient and effective for their intended purpose; provide not less than one extinguisher on each floor at or near each usable stairwell.

2. Store combustible materials in containers in fire-safe locations.
3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting. Prohibit smoking in hazardous fire-exposure areas.
4. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
5. Permanent Fire Protection: At earliest feasible date in each area of Project, complete installation of permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.
6. Develop and supervise an overall fire-prevention and first-aid fire-protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
7. Provide hoses for fire protection of sufficient length to reach construction areas. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage caused by freezing temperatures and similar elements.
 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
 2. Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.
- C. Temporary Facility Changeover: Except for using permanent fire protection as soon as available, do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 1. Materials and facilities that constitute temporary facilities are the property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.

3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 1 Section "Closeout Procedures."

END OF SECTION 01500

SECTION 01600 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following administrative and procedural requirements: selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. Related Sections include the following:
 - 1. Division 1 Section "Alternates" for products selected under an alternate.
 - 2. Division 1 Section "Closeout Procedures" for submitting warranties for contract closeout.
 - 3. Divisions 2 through 16 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service

performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

- D. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
- E. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

1.4 SUBMITTALS

- A. Product List: Submit a list, in tabular form, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.
 - 1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
 - 2. Form: Tabulate information for each product under the following column headings:
 - a. Specification Section number and title.
 - b. Generic name used in the Contract Documents.
 - c. Proprietary name, model number, and similar designations.
 - d. Manufacturer's name and address.
 - e. Supplier's name and address.
 - f. Installer's name and address.
 - g. Projected delivery date or time span of delivery period.
 - h. Identification of items that require early submittal approval for scheduled delivery date.
 - 3. Initial Submittal: Within 30 days after date of commencement of the Work, submit 3 copies of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.
 - a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established early in Contract period.
 - 4. Completed List: Within 60 days after date of commencement of the Work, submit 3 copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
 - 5. Architect's Action: Architect will respond in writing to Contractor within 15 days of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement that products comply with the Contract Documents.
- B. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use CSI Form 13.1A, form provided by Owner or form provided at end of Section.
 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified material or product cannot be provided.
 - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
 - i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
 - j. Cost information, including a proposal of change, if any, in the Contract Sum.
 - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
 - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
 3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
 - a. Form of Acceptance: Change Order.
 - b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.
- C. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 Section "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
 - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
 - 5. Store products to allow for inspection and measurement of quantity or counting of units.
 - 6. Store materials in a manner that will not endanger Project structure.
 - 7. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 - 8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 9. Protect stored products from damage.
- B. Storage: Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: Forms are included with the Specifications. Prepare a written document using appropriate form properly executed.

3. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 1 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT OPTIONS

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures: Procedures for product selection include the following:

1. Product: Where Specification paragraphs or subparagraphs titled "Product" name a single product and manufacturer, provide the product named.
 - a. Substitutions may be considered, unless otherwise indicated.
2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name single manufacturers or sources, provide a product by the manufacturer or from the source named that complies with requirements.
 - a. Substitutions may be considered, unless otherwise indicated.
3. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
 - a. Substitutions may be considered, unless otherwise indicated.

4. Manufacturers: Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
 - a. Substitutions may be considered, unless otherwise indicated.
5. Available Products: Where Specification paragraphs or subparagraphs titled "Available Products" introduce a list of names of both products and manufacturers, provide one of the products listed or another product that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
6. Available Manufacturers: Where Specification paragraphs or subparagraphs titled "Available Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed or another manufacturer that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
7. Product Options: Where Specification paragraphs titled "Product Options" indicate that size, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide either the specific product or system indicated or a comparable product or system by another manufacturer. Comply with provisions in "Product Substitutions" Article.
8. Basis-of-Design Products: Where Specification paragraphs or subparagraphs titled "Basis-of-Design Product[s]" are included and also introduce or refer to a list of manufacturers' names, provide either the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. Substitutions may be considered, **unless otherwise indicated**.
9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product (and manufacturer) that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches satisfactorily.
 - a. If no product available within specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents on "substitutions" for selection of a matching product.
10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product (and manufacturer) that complies with other specified requirements.
 - a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that does not include premium items.
 - b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

- A. Timing: Architect will consider requests for substitution if received within 30 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.
- B. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - 1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - 2. Requested substitution does not require extensive revisions to the Contract Documents.
 - 3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - 4. Substitution request is fully documented and properly submitted.
 - 5. Requested substitution will not adversely affect Contractor's Construction Schedule.
 - 6. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - 7. Requested substitution is compatible with other portions of the Work.
 - 8. Requested substitution has been coordinated with other portions of the Work.
 - 9. Requested substitution provides specified warranty.
 - 10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

2.3 COMPARABLE PRODUCTS

- A. Where products or manufacturers are specified by name, submit the following, in addition to other required submittals, to obtain approval of an unnamed product:
 - 1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 - 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - 3. Evidence that proposed product provides specified warranty.
 - 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 - 5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01600

SECTION 01700 - EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. General installation of products.
 - 4. Coordination of Owner-installed products.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.
 - 8. Correction of the Work.
- B. Related Sections include the following:
 - 1. Division 1 Section "Submittal Procedures" for submitting surveys.
 - 2. Division 1 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
 - 3. Division 1 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording any of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.3 SUBMITTALS

- A. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.

1.4 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

PART 2 - PRODUCTS (Not Used)

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are **not guaranteed**. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
 - 1. Before construction, verify the location and points of connection of utility services.
- B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are **not guaranteed**. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - a. Description of the Work.
 - b. List of detrimental conditions, including substrates.
 - c. List of unacceptable installation tolerances.
 - d. Recommended corrections.
 - 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility, architect and Owner's Project Manager that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Architect and Owner not less than ten days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without **Architect's** and **Owner's** written permission.
- C. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- D. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- E. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents. Submit requests on CSI Form 13.2A, "Request for Interpretation" or the General Contractor's standard form.

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 3. Inform installers of lines and levels to which they must comply.
 - 4. Check the location, level and plumb, of every major element as the Work progresses.
 - 5. Notify Architect and Owner's Project Manager when deviations from required lines and levels exceed allowable tolerances.
 - 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and

electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect and Owner's Project Manager.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect or Owner's Project Manager. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect and Construction Manager before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of 8 feet (2.4 m) in spaces without a suspended ceiling.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
- G. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- H. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction forces.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction forces at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.

3.7 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F (27 deg C).
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.
 - 1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.
- H. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- J. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- K. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.10 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section "Cutting and Patching."
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01700

SECTION 01731 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. Related Sections include the following:
 - 1. Divisions 2 through 16 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
 - a. Requirements in this Section apply to mechanical and electrical installations. Refer to Divisions 15 and 16 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.3 DEFINITIONS

- A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
 - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
 - 2. Changes to Existing Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
 - 3. Products: List products to be used and firms or entities that will perform the Work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.

6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
7. Architect and Owner's designated representative Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch the following operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 1. Primary operational systems and equipment.
 2. Air or smoke barriers.
 3. Fire-protection systems.
 4. Control systems.
 5. Communication systems.
 6. Conveying systems.
 7. Electrical wiring systems.
 8. Operating systems of special construction in Division 13 Sections.
- C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 1. Water, moisture, or vapor barriers.
 2. Membranes and flashings.
 3. Exterior curtain-wall construction.
 4. Equipment supports.
 5. Piping, ductwork, vessels, and equipment.
 6. Noise- and vibration-control elements and systems.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
 1. If possible, retain original Installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm.
 - a. Processed concrete finishes.
 - b. Stonework and stone masonry.
 - c. Ornamental metal.

- d. Matched-veneer woodwork.
 - e. Preformed metal panels.
 - f. Roofing.
 - g. Firestopping.
 - h. Curtain wall system, storefront.
 - i. Finished wood flooring.
 - j. Aggregate wall coating.
 - k. Wall covering.
 - l. HVAC enclosures, cabinets, or covers.
- E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.6 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections of these Specifications.
- B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
- 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
- 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

CUTTING AND PATCHING

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to avoid interruption of services to occupied areas.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

END OF SECTION 01731

SECTION 01732 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Demolition and removal of selected portions of a building or structure.
2. Demolition and removal of selected site elements.
3. Repair procedures for selective demolition operations.

- B. Related Sections include the following:

1. Division 1 Section "Summary" for use of the premises and phasing requirements.
2. Division 1 Section "Work Restrictions" for restrictions on use of the premises due to Owner or tenant occupancy.
3. Division 1 Section "Construction Progress Documentation" for preconstruction photographs taken before selective demolition.
4. Division 1 Section "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for selective demolition operations.
5. Division 1 Section "Cutting and Patching" for cutting and patching procedures for selective demolition operations.
6. Division 2 Section "Site Clearing" for site clearing and removal of above- and below-grade improvements.
7. Division 15 Sections for demolishing, cutting, patching, or relocating mechanical items.
8. Division 16 Sections for demolishing, cutting, patching, or relocating electrical items.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.
- B. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered during selective demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.
 - 1. Coordinate with Owner's historical adviser, who will establish special procedures for removal and salvage.

1.5 SUBMITTALS

- A. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.
- B. Predemolition Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.

1.6 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Standards: Comply with ANSI A10.6 and NFPA 241.
- D. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.7 PROJECT CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
- B. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
 - 1. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.

- C. Owner assumes no responsibility for condition of areas to be selectively demolished.
 - 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - 2. Before selective demolition, Owner will remove the following items:
 - a. To be determined
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site will not be permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.8 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.
 - 1. If possible, retain original Installer or fabricator to patch the exposed Work listed below that is damaged during selective demolition. If it is impossible to engage original Installer or fabricator, engage another recognized experienced and specialized firm.
 - a. Processed concrete finishes.
 - b. Stonework and stone masonry.
 - c. Preformed metal panels.
 - d. Roofing.
 - e. Firestopping.
 - f. Window wall system.
 - g. HVAC enclosures, cabinets, or covers.

PART 2 - PRODUCTS

2.1 REPAIR MATERIALS

- A. Use repair materials identical to existing materials.
 - 1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 2. Use materials whose installed performance equals or surpasses that of existing materials.

- B. Comply with material and installation requirements specified in individual Specification Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.
- F. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES

- A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.
- B. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.
 - 1. Provide at least 72 hours' notice to Owner if shutdown of service is required during changeover.
- C. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated utilities when requested by Contractor.
 - 2. Arrange to shut off indicated utilities with utility companies.
 - 3. If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.
 - 4. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

- D. Utility Requirements: Refer to Division 15 and 16 Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.3 PREPARATION

- A. Dangerous Materials: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
 - 2. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
 - 3. Protect existing site improvements, appurtenances, and landscaping to remain.
 - 4. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
- C. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
- D. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
- E. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
- F. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to

remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.4 POLLUTION CONTROLS

- A. Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.
 1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
 2. Wet mop floors to eliminate trackable dirt and wipe down walls and doors of demolition enclosure. Vacuum carpeted areas.
- B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- C. Cleaning: Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.5 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 9. Dispose of demolished items and materials promptly.
 10. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
- B. Existing Facilities: Comply with building manager's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.
- C. Removed and Salvaged Items: Comply with the following:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.
 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items: Comply with the following:
1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.
- F. Concrete: Demolish in small sections. Cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain, using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition. Neatly trim openings to dimensions indicated.
- G. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.
- H. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- I. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

- J. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.
 - 1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.
- K. Roofing: Remove no more existing roofing than can be covered in one day by new roofing. Refer to applicable Division 7 Section for new roofing requirements.
- L. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

3.6 PATCHING AND REPAIRS

- A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.
- B. Patching: Comply with Division 1 Section "Cutting and Patching."
- C. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
 - 1. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.
- D. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.
- E. Floors and Walls: Where walls or partitions that are demolished extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - 1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
 - 2. Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
 - 3. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
- F. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.

- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

END OF SECTION 01732

SECTION 01770 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Inspection procedures.
 - 2. Project Record Documents.
 - 3. Operation and maintenance manuals.
 - 4. Warranties.
 - 5. Instruction of Owner's personnel.
 - 6. Final cleaning.
- B. Related Sections include the following:
 - 1. Division 1 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
 - 2. Division 1 Section "Construction Progress Documentation" for submitting Final Completion construction photographs and negatives.
 - 3. Division 1 Section "Execution Requirements" for progress cleaning of Project site.
 - 4. Divisions 2 through 16 Sections for specific closeout and special cleaning requirements for products of those Sections.

1.3 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
 - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 - 2. Advise Owner of pending insurance changeover requirements.
 - 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.

5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
 6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
 7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 8. Complete startup testing of systems.
 9. Submit test/adjust/balance records.
 10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 11. Advise Owner of changeover in heat and other utilities.
 12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 13. Complete final cleaning requirements, including touchup painting.
 14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect and Owner's designated representative will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for Final Completion.

1.4 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
1. Submit a final Application for Payment according to Division 1 Section "Payment Procedures."
 2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect and Owner's Designated Representative will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment

after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit 3 copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect
 - d. Name of Contractor.
 - e. Page number.

1.6 PROJECT RECORD DOCUMENTS

- A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.
- B. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings.
 1. Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
 - a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later.
 - b. Accurately record information in an understandable drawing technique.
 - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 - d. Mark Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.
 2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.

3. Mark important additional information that was either shown schematically or omitted from original Drawings.
 4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.
 5. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.
- C. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Note related Change Orders, Record Drawings, and Product Data, where applicable.
- D. Record Product Data: Submit one copy of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, Record Drawings, and Record Specifications, where applicable.
- E. Miscellaneous Record Submittals: Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

1.7 OPERATION AND MAINTENANCE MANUALS

- A. Assemble a complete set of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:
1. Operation Data:
 - a. Emergency instructions and procedures.
 - b. System, subsystem, and equipment descriptions, including operating standards.
 - c. Operating procedures, including startup, shutdown, seasonal, and weekend operations.
 - d. Description of controls and sequence of operations.
 - e. Piping diagrams.
 2. Maintenance Data:

- a. Manufacturer's information, including list of spare parts.
 - b. Name, address, and telephone number of Installer or supplier.
 - c. Maintenance procedures.
 - d. Maintenance and service schedules for preventive and routine maintenance.
 - e. Maintenance record forms.
 - f. Sources of spare parts and maintenance materials.
 - g. Copies of maintenance service agreements.
 - h. Copies of warranties and bonds.
- B. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.

1.8 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive **8-1/2-by-11-inch (115-by-280-mm)** paper.
 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

3.1 DEMONSTRATION AND TRAINING

- A. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Provide instructors experienced in operation and maintenance procedures.
 - 2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
 - 3. Schedule training with Owner through Owner's designated representative with at least 7 days advance notice.
 - 4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.
- B. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction for the following:
 - 1. System design and operational philosophy.
 - 2. Review of documentation.
 - 3. Operations.
 - 4. Adjustments.
 - 5. Troubleshooting.
 - 6. Maintenance.
 - 7. Repair.

3.2 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and anti-pollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.

- d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
 - m. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Replace parts subject to unusual operating conditions.
 - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - q. Clean ducts, blowers, and coils if units were operated without filters during construction.
 - r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - s. Leave Project clean and ready for occupancy.
- C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.
- D. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 01770

SECTION 02230 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Protecting existing trees and vegetation to remain.
2. Removing trees and other vegetation.
3. Clearing and grubbing.
4. Topsoil stripping.
5. Removing above-grade site improvements.

- B. Related Sections include the following:

1. Division 1 Section "Field Engineering" for verifying utility locations and for recording field measurements.
2. Division 1 Section "Construction Facilities and Temporary Controls" for temporary utilities, temporary construction and support facilities, temporary security and protection facilities, and environmental protection measures during site operations.
3. Division 2 Section "Building Demolition" for demolition of buildings, structures, and site improvements.
4. Division 2 Section "Earthwork" for soil materials, excavating, backfilling, and site grading.

1.3 DEFINITIONS

- A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches (50 mm) in diameter; and free of weeds, roots, and other deleterious materials.

1.4 MATERIALS OWNERSHIP

- A. Except for materials indicated to be stockpiled or to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from the site.

1.5 SUBMITTALS

- A. Photographs sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.
- B. Record drawings according to Division 1 Section "Contract Closeout."
 - 1. Identify and accurately locate capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

- A. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."
- B. [A Geo Consultants representative shall confirm that unsuitable soils have been removed prior to importing fill.](#)

1.7 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing indicated removal and alteration work on property adjoining Owner's property will be obtained by Owner before award of Contract.
- C. Notify utility locator service for area where Project is located before site clearing.
- D. [Dust Control: Keep dust at a minimum at all times during construction.](#)

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 2 Section "Earthwork."
 - 1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Locate and clearly flag trees and vegetation to remain or to be relocated.
- D. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TREE PROTECTION

- A. Erect and maintain a temporary fence around drip line of individual trees or around perimeter drip line of groups of trees to remain. Remove fence when construction is complete.
 - 1. Do not store construction materials, debris, or excavated material within drip line of remaining trees.
 - 2. Do not permit vehicles, equipment, or foot traffic within drip line of remaining trees.
- B. Do not excavate within drip line of trees, unless otherwise indicated.
- C. Where excavation for new construction is required within drip line of trees, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
- D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

3.3 UTILITIES

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
 - 1. Arrange to shut off indicated utilities with utility companies.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Architect not less than two days in advance of proposed utility interruptions.
- C. Excavate for and remove underground utilities indicated to be removed.

3.4 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
 3. Completely remove stumps, roots, obstructions, and debris extending to a depth of **18 inches (450 mm)** below exposed subgrade.
 4. Use only hand methods for grubbing within drip line of remaining trees.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
1. Place fill material in horizontal layers not exceeding **8-inch (200-mm)** loose depth, and compact each layer to a density equal to adjacent original ground.
- C. Over excavations shall extend laterally a minimum of 5 feet beyond the perimeter of the structure and / or foundations and 3 feet beyond exterior flatwork and pavement areas, or to a distance equal to the depth of over excavation, whichever is greater.
- D. A Geo Consultants representative shall confirm that the recommended removals of unsatisfactory soils have been accomplished.
- E. Native soils exposed after over excavation shall be scarified to a depth of at least 6 inches, moisture conditioned to within 2 percent of the optimum moisture content for granular soils, and slightly above optimum for fine-grained soils, and re-compacted to at least 90 percent of maximum dry density by D-1557

3.5 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
1. Strip surface soil of unsuitable topsoil, including trash, debris, weeds, roots, and other waste materials.

3.6 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

3.7 DISPOSAL

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 02230

SECTION 02231 - TREE PROTECTION AND TRIMMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the protection and trimming of trees that interfere with, or are affected by, execution of the Work, whether temporary or new construction.
- B. Related Sections include the following:
 - 1. Division 1 Section "Summary of Work" for limits placed on Contractor's use of the site.
 - 2. Division 1 Section "Construction Facilities and Temporary Controls" for temporary tree protection.
 - 3. Division 2 Section "Site Clearing" for removal limits of trees, shrubs, and other plantings affected by new construction.
 - 4. Division 2 Section "Earthwork" for building and utility trench excavation, backfilling, compacting and grading requirements, and soil materials.
 - 5. Division 2 Section "Landscaping" for tree and shrub planting and transplanting, tree support systems, and soil materials.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- C. Certification: From a qualified arborist that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.
- D. Maintenance Recommendations: From a qualified arborist for care and protection of trees affected by construction during and after completing the Work.

1.4 QUALITY ASSURANCE

- A. Tree Service Qualifications: An experienced tree service firm that has successfully completed tree protection and trimming work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site on a full-time basis during execution of the Work.
- B. Arborist Qualifications: An arborist certified by the International Society of Arboriculture or licensed in the jurisdiction where Project is located, (Campus Arborist to be consulted).

- C. Tree Pruning Standards: Comply with ANSI A300, "Trees, Shrubs, and Other Woody Plant Maintenance--Standard Practices," unless more stringent requirements are indicated.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."
 - 1. Before starting tree protection and trimming, meet with representatives of authorities having jurisdiction, Owner, Architect, consultants, and other concerned entities. Review tree protection and trimming procedures and responsibilities. Notify participants at least three working days before convening conference. Record discussions and agreements and furnish a copy to each participant.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Drainage Fill: Selected crushed stone, or crushed or uncrushed gravel, washed, ASTM D 448, Size 24, with 90 to 100 percent passing a 2-1/2-inch (63-mm) sieve and not more than 10 percent passing a 3/4-inch (19-mm) sieve.
- B. Topsoil: Fertile, friable, surface soil, containing natural loam and complying with ASTM D 5268. Provide topsoil that is free of stones larger than 1 inch (25 mm) in any dimension and free of other extraneous or toxic matter harmful to plant growth. Obtain topsoil only from well-drained sites where soil occurs in depth of 4 inches (100 mm) or more; do not obtain from bogs or marshes.
- C. Filter Fabric: Manufacturer's standard, nonwoven, pervious, geotextile fabric of polypropylene, nylon, or polyester fibers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect tree root systems from damage due to noxious materials caused by runoff or spillage while mixing, placing, or storing construction materials. Protect root systems from flooding, eroding, or excessive wetting caused by dewatering operations.
- B. Do not store construction materials, debris, or excavated material within the drip line of remaining trees. Do not permit vehicles or foot traffic within the drip line; prevent soil compaction over root systems.
- C. Do not allow fires under or adjacent to remaining trees or other plants.

3.2 EXCAVATION

- A. Install shoring or other protective support systems to minimize sloping or benching of excavations.
- B. Do not excavate within drip line of trees, unless otherwise indicated.
- C. Where excavation for new construction is required within drip line of trees, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks and comb soil to expose roots.

1. Relocate roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and relocate them without breaking. If encountered immediately adjacent to location of new construction and relocation is not practical, cut roots approximately 3 inches (75 mm) back from new construction.
 2. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.
- D. Where utility trenches are required within drip line of trees, tunnel under or around roots by drilling, auger boring, pipe jacking, or digging by hand.
1. Root Pruning: Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots with sharp pruning instruments; do not break or chop.

3.3 REGRADING

- A. Grade Lowering: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by qualified arborist, unless otherwise indicated.
1. Root Pruning: Prune tree roots exposed during grade lowering. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots with sharp pruning instruments; do not break or chop.
- B. Minor Fill: Where existing grade is 6 inches (150 mm) or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.
- C. Moderate Fill: Where existing grade is more than 6 inches (150 mm), but less than 12 inches (300 mm), below elevation of finish grade, place drainage fill, filter fabric, and topsoil on existing grade as follows:
1. Carefully place drainage fill against tree trunk approximately 2 inches (50 mm) above elevation of finish grade and extend not less than 18 inches (450 mm) from tree trunk on all sides. For balance of area within drip-line perimeter, place drainage fill up to 6 inches (150 mm) below elevation of grade.
 2. Place filter fabric with edges overlapping 6 inches (150 mm) minimum.
 3. Place fill layer of topsoil to finish grade. Do not compact drainage fill or topsoil. Hand grade to required finish elevations.

3.4 TREE PRUNING

- A. Prune remaining trees affected by temporary and new construction.
- B. Prune remaining trees to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by qualified arborist (Campus Arborist).
- C. Pruning Standards: Prune trees according to ANSI A300 as follows:
1. Type of Pruning: Crown cleaning.
- D. Cut branches with sharp pruning instruments; do not break or chop.
- E. Chip branches removed from trees. Spread chips where indicated or as directed by Architect.

3.5 TREE REPAIR AND REPLACEMENT

- A. Promptly repair trees damaged by construction operations within 24 hours. Treat damaged trunks, limbs, and roots according to written instructions of the qualified arborist.
- B. Remove and replace dead and damaged trees that the qualified arborist determines to be incapable of restoring to a normal growth pattern (Campus Arborist to be consulted).
 - 1. Provide new trees of 6-inch (150-mm) caliper size and of a species selected by Campus Arborist when trees more than 6 inches (150 mm) in caliper size, measured 12 inches (300 mm) above grade, are required to be replaced.
- C. Aerate surface soil, compacted during construction, 10 feet (3 m) beyond drip line and no closer than 36 inches (900 mm) to tree trunk. Drill 2-inch- (50-mm-) diameter holes a minimum of 12 inches (300 mm) deep at 24 inches (600 mm) o.c. Backfill holes with an equal mix of augered soil and sand.

3.6 DISPOSAL OF WASTE MATERIALS

- A. Burning is not permitted.
- B. Disposal: Remove excess excavated material, displaced trees, and excess chips from Owner's property.

END OF SECTION 02231

SECTION 02260 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes temporary excavation support and protection systems.
- B. Related Sections include the following:
 - 1. Division 1 Section "Temporary Facilities and Controls" for temporary utilities and support facilities.
 - 2. Division 2 Section "Earthwork" for excavating and backfilling and for existing utilities.

1.3 PERFORMANCE REQUIREMENTS

- A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.
 - 1. Provide professional engineering services needed to assume engineering responsibility, including preparation of Shop Drawings and a comprehensive engineering analysis by a qualified professional engineer.
 - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 3. Install excavation support and protection systems without damaging existing buildings, pavements, and other improvements adjacent to excavation.

1.4 SUBMITTALS

- A. Shop Drawings for Information: Prepared by or under the supervision of a qualified professional engineer for excavation support and protection systems.
 - 1. Include Shop Drawings signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Qualification Data: For Installer and professional engineer.
- C. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of excavation support and protection systems.

1.5 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.
- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.
 - 1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection.
 - 2. The geotechnical report is included elsewhere in the Project Manual.
- C. Survey adjacent structures and improvements, employing a qualified professional engineer or land surveyor; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.
 - 1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that are either new or in serviceable condition.
- B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.
- C. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.
- D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of 3 inches (75 mm).
- E. Shotcrete: Comply with Division 3 Section "Shotcrete" for shotcrete materials and mixes, reinforcing, and shotcrete application.
- F. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.
- G. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
 - 1. Shore, support, and protect utilities encountered.

- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces is not impeded.
- D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.
- E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

3.2 SOLDIER BEAMS AND LAGGING

- A. Install steel soldier beams before starting excavation. Space soldier beams at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches (50 mm) from a horizontal line and not more than 1:120 out of vertical alignment.
- B. Install wood lagging within flanges of soldier beams as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.
- C. Install wales horizontally at centers indicated and secure to soldier beams.

3.3 SHEET PILING

- A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. Limit vertical offset of adjacent sheet piling to 60 inches (1500 mm). Accurately align exposed faces of sheet piling to vary not more than 2 inches (50 mm) from a horizontal line and not more than 1:120 out of vertical alignment. Cut tops of sheet piling to uniform elevation at top of excavation.

3.4 TIEBACKS

- A. Tiebacks: Drill for, install, grout, and tension tiebacks into position. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.
 - 1. Test loading shall be observed by a qualified professional engineer responsible for design of excavation support and protection system.
 - 2. Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.5 BRACING

- A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.

1. Do not place bracing where it will be cast into or included in permanent concrete work, unless otherwise approved by Architect.
2. Install internal bracing, if required, to prevent spreading or distortion of braced frames.
3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.
 1. Remove excavation support and protection systems to a minimum depth of 48 inches (1200 mm) below overlying construction and abandon remainder.
 2. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.
- B. Leave excavation support and protection systems permanently in place.

END OF SECTION 02260

SECTION 02741 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Hot-mix asphalt patching.
 - 2. Hot-mix asphalt paving.

- B. Related Sections:

- 1. Division 2 Sections for other paving installed as part of crosswalks in asphalt pavement areas.
 - 2. Division 2 Section "Building Demolition" for demolition, removal, and recycling of existing asphalt pavements, and for geotextiles that are not embedded within courses of asphalt paving.
 - 3. Division 2 Section "Earthwork" for aggregate subbase and base courses and for aggregate pavement shoulders.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
 - 1. Job-Mix Designs: For each job mix proposed for the Work.
- B. Samples: For each paving fabric, 12 by 12 inches (300 by 300 mm) minimum.
- C. Material Certificates: For each paving material, from manufacturer.
- D. Material Test Reports: For each paving material.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Engage a firm experienced in manufacturing hot-mix asphalt similar to that indicated for this Project and with a record of successful in-service performance.

- B. Installer Qualifications: Engage an experienced installer who has complete hot-mix asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- C. Regulatory Requirements: Conform to applicable standards of authorities having jurisdiction for any asphalt paving work on public property. Asphalt-Paving Publication: Comply with AI's "The Asphalt Handbook," except where more stringent requirements are indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
- B.
 - 1. Tack Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
 - 2. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
 - 3. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations.
- B. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.
- C. Fine Aggregate: ASTM D 1073 sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.
 - 1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.
- D. Mineral Filler: ASTM D 242 rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

- A. Asphalt Cement: ASTM D 3381 for viscosity-graded material; ASTM D 946 for penetration-graded material.
- B. Undersealing Asphalt: ASTM D 3141, pumping consistency.
- C. Tack Coat: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.
- D. Water: Potable.

2.3 AUXILIARY MATERIALS

- A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.
- B. Sand: ASTM D 1073, Grade Nos. 2 or 3.
- C. Glass Beads: AASHTO M 247, Type 1.

2.4 MIXES

- A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and designed according to procedures in AIMS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types."
 - 1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
 - 2. Provide mixes complying with composition, grading, and tolerance requirements in ASTM D 3515 for the following nominal, maximum aggregate sizes:
 - a. Surface Course: **1/2 inch (13 mm)**.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
- C. Notify architect in writing of any unsatisfactory conditions. Do not begin paving installation until these conditions have been satisfactorily corrected. Retain paragraph below if imprinted asphalt paving is required.

3.2 PATCHING AND REPAIRS

- A. Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending **12 inches (300 mm)** into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompress existing unbound-aggregate base course to form new subgrade.
 - 1. Tack coat faces of excavation and allow to cure before paving.
 - 2. Fill excavation with dense-graded, hot-mix asphalt base mix and, while still hot, compact flush with adjacent surface.
 - 3. Partially fill excavation with dense-graded, hot-mix asphalt base mix and compact while still hot. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.
- B. Leveling Course: Install and compact leveling course consisting of dense-graded, hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch (25 mm) in existing pavements.
 - 1. Install leveling wedges in compacted lifts not exceeding 3 inches (75 mm) thick.
- C. Tack Coat: Apply uniformly to existing surfaces of previously constructed asphalt or Portland cement concrete paving and to surfaces abutting or projecting into new, hot-mix asphalt pavement. Apply at a uniform rate of **0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m)**.
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- D. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.3 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B.
 - 1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.
- C. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

3.4 PAVING GEOTEXTILE INSTALLATION

- A. Apply bond coat, consisting of asphalt cement, uniformly to existing pavement surfaces at a rate of **0.20 to 0.30 gal./sq. yd.** (**0.8 to 1.2 L/sq. m**).
- B. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints **4 inches** (**100 mm**) and transverse joints **6 inches** (**150 mm**).
 - 1. Protect paving geotextile from traffic and other damage and place hot-mix asphalt paving overlay the same day.

3.5 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
 - 1. Place hot-mix asphalt surface course in single lift.
 - 2. Spread mix at minimum temperature of **250 deg F** (**121 deg C**).
 - 3. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
 - 4. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than **10 feet** (**3 m**) wide unless infill edge strips of a lesser width are required.
 - 1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.6 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

3.7 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to **185 deg F (85 deg C)**.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927 but not less than 94 percent nor greater than 100 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.8 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 1. Surface Course: Plus **1/4 inch (6 mm)**, no minus.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a **10-foot (3-m)** straightedge applied transversely or longitudinally to paved areas:
 1. Surface Course: **1/8 inch (3 mm)**.
 2. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is **1/4 inch (6 mm)**.

END OF SECTION 02741

SECTION 02300 - EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns, and plantings.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for slabs-on-grade.
4. Subbase course for concrete walks and pavements.
5. Base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches within building lines.
8. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.

- B. Related Sections include the following:

1. Division 1, Section 01270 Unit Prices, for a schedule of unit prices.
2. Division 1, Section 01500 Construction Facilities and Temporary Controls.
3. Division 2, Section 02230 Site Clearing, for site stripping, grubbing, removing topsoil, and protecting trees to remain.
4. Division 2, Section 02240 Dewatering, for lowering and disposing of ground water during construction.
5. Division 2, Section 02231 Tree Protection and Trimming, for protecting and trimming trees to remain.
6. Division 2, Section 02260 Excavation Support and Protection.
7. Division 7, Section 07130 and 07141 for drainage of footings, slabs-on-grade, and walls.
8. Division 3 Section "Cast-in-Place Concrete" for granular course over vapor retarder.
9. Division 15 and 16 Sections for excavating and backfilling buried mechanical and electrical utilities and buried utility structures.

1.3 DEFINITIONS

- A. Backfill: Soil materials used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

- B. Base Course: Layer placed between the subbase course and asphalt paving.
- C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations.
 - 1. Additional Excavation: Excavation below subgrade elevations as directed by Architect. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 - 2. Bulk Excavation: Excavations more than **10 feet** in width and pits more than **30 feet** in either length or width.
 - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- I. Subbase Course: Layer placed between the subgrade and base course for asphalt paving, or layer placed between the subgrade and a concrete pavement or walk.
- J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- K. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Drainage fabric.
 - 2. Separation fabric.
- B. Samples: For the following:
 - 1. **3-lb** samples, sealed in airtight containers, of each proposed soil material from on-site or borrow sources.
 - 2. **12-by-12-inch** sample of drainage fabric.
 - 3. **12-by-12-inch** sample of separation fabric.
- C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D 2487 of each borrow soil material proposed for fill and backfill.
 2. Laboratory compaction curve according to ASTM D 698 for each borrow soil material proposed for fill and backfill.
- D. Blasting plan approved by authorities having jurisdiction, for record purposes.
- E. Seismic survey agency report, for record purposes.

1.5 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.
- B. Preexcavation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify Architect and Project Manager not less than two days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Architect's and Construction Manager's written permission.
 3. Contact utility-locator service for area where Project is located before excavating.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
 2. Soil classifications GC, SC maybe used as fill under pavements.
- D. Backfill and Fill: Satisfactory soil materials.
- E. Subbase: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2- inch sieve and not more than 12 percent passing a No. 200 sieve.
- F. Base: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
- G. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 38-mm sieve and not more than 12 percent passing a No. 200 sieve.
- H. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- I. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2- inch sieve and 0 to 5 percent passing a No. 8 sieve.
- J. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
1. Red: Electric.
 2. Yellow: Gas, oil, steam, and dangerous materials.
 3. Orange: Telephone and other communications.
 4. Blue: Water systems.
 5. Green: Sewer systems.
- B. Drainage Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:

1. Grab Tensile Strength: **110 lbf** ; ASTM D 4632.
2. Tear Strength: **40 lbf** ; ASTM D 4533.
3. Puncture Resistance: **50 lbf** ; ASTM D 4833.
4. Water Flow Rate: **150 gpm per sq. ft.** ; ASTM D 4491.
5. Apparent Opening Size: **No. 50** ; ASTM D 4751.

- C. Separation Fabric: Woven geotextile, specifically manufactured for use as a separation geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:

1. Grab Tensile Strength: **200 lbf** ; ASTM D 4632.
2. Tear Strength: **75 lbf** ; ASTM D 4533.
3. Puncture Resistance: **90 lbf** ; ASTM D 4833.
4. Water Flow Rate: **4 gpm per sq. ft.** ; ASTM D 4491.
5. Apparent Opening Size: **No. 30** ; ASTM D 4751.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.
- C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
 2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXCAVATION, GENERAL

- A. Classified Excavation: Excavation to subgrade elevations classified as earth.

1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.

3.4 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus **1 inch**. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus **1 inch**. Do not disturb bottom of excavations intended for bearing surface.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

3.6 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

- B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to **12 inches** higher than top of pipe or conduit, unless otherwise indicated.

1. Clearance: As indicated.

- C. Trench Bottoms: Excavate trenches **4 inches** deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.

1. Excavate trenches **6 inches** deeper than elevation required in unyielding bearing material to allow for bedding course.

3.7 APPROVAL OF SUBGRADE

- A. Notify Architect when excavations have reached required subgrade.

- B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- C. Proof roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect.

3.8 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used when approved by Architect.
 1. Fill unauthorized excavations under other construction or utility pipe as directed by Architect.

3.9 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 1. Construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
 2. Surveying locations of underground utilities for record documents.
 3. Inspecting and testing underground utilities.
 4. Removing concrete formwork.
 5. Removing trash and debris.
 6. Removing temporary shoring and bracing, and sheeting.
 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.11 UTILITY TRENCH BACKFILL

- A. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

- B. Backfill trenches excavated under footings and within **18 inches** of bottom of footings; fill with concrete to elevation of bottom of footings.
- C. Place and compact initial backfill of subbase material, free of particles larger than **1 inch** , to a height of **12 inches** over the utility pipe or conduit.
 - 1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
- D. Coordinate backfilling with utilities testing.
- E. Fill voids with approved backfill materials while shoring and bracing, and as sheeting is removed.
- F. Place and compact final backfill of satisfactory soil material to final subgrade.
- G. Install warning tape directly above utilities, **12 inches** below finished grade, except **6 inches** below subgrade under pavements and slabs.

3.12 FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under walks and pavements, and in all areas affected by construction, except for areas listed below, use satisfactory soil material.
 - 2. Under steps and ramps, use engineered fill.
 - 3. Under building slabs, use engineered fill.
 - 4. Under footings and foundations, use engineered fill.

3.13 MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.14 COMPACTION OF BACKFILLS AND FILLS

- A. Place backfill and fill materials in layers not more than **8 inches** in loose depth for material compacted by heavy compaction equipment, and not more than **4 inches** in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
- D. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top **12 inches** of existing subgrade and each layer of backfill or fill material at 95 percent.
 - 2. Under walkways, scarify and recompact top **6 inches** below subgrade and compact each layer of backfill or fill material at 92 percent.
 - 3. Under lawn or unpaved areas, scarify and recompact top **6 inches** below subgrade and compact each layer of backfill or fill material at 85 percent.

3.15 GRADING

- A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Lawn or Unpaved Areas: Plus or minus **1 inch**.
 - 2. Walks: Plus or minus **1 inch**.
 - 3. Pavements: Plus or minus **1/2 inch**.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of **1/2 inch** when tested with a **10-foot** straightedge.

3.16 SUBBASE AND BASE COURSES

- A. Under pavements and walks, place subbase course on prepared subgrade and as follows:
 - 1. Place base course material over subbase.
 - 2. Compact subbase and base courses at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.
 - 3. Shape subbase and base to required crown elevations and cross-slope grades.

4. When thickness of compacted subbase or base course is **6 inches** or less, place materials in a single layer.
5. When thickness of compacted subbase or base course exceeds **6 inches**, place materials in equal layers, with no layer more than **6 inches** thick or less than **3 inches** thick when compacted.

- B. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least **12 inches** wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.17 DRAINAGE COURSE

- A. Refer to attached soils/geotechnical report.

3.18 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every **2000 sq. ft.** or less of paved area or building slab, but in no case fewer than three tests.
 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for each **100 feet** or less of wall length, but no fewer than two tests.
 3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each **150 feet** or less of trench length, but no fewer than two tests.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.19 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.20 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.
 - 1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 02300

SECTION 02751 - CEMENT CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes exterior cement concrete pavement for the following:
 - 1. Curbs and gutters.
 - 2. Walkways.
- B. Related Sections include the following:
 - 1. Division 2 Section "Earthwork" for subgrade preparation, grading, and subbase course.
 - 2. Division 3 Section "Cast-in-Place Concrete" for general building applications of concrete.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, expansive hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.4 SUBMITTALS

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixes: For each concrete pavement mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Samples: 10-lb (4.5-kg) sample of exposed aggregate.
- D. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:
 - 1. Cementitious materials and aggregates.
 - 2. Steel reinforcement and reinforcement accessories.

3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or adhesive.
8. Joint fillers.

1.5 QUALITY ASSURANCE

- A. **Installer Qualifications:** An experienced installer who has completed pavement work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. **Manufacturer Qualifications:** Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
 1. Manufacturer must be certified according to the National Ready Mix Concrete Association's Plant Certification Program.
- C. **Source Limitations:** Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.
- D. **ACI Publications:** Comply with ACI 301, "Specification for Structural Concrete," unless modified by the requirements of the Contract Documents.
- E. **Concrete Testing Service:** Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixes.

1.6 PROJECT CONDITIONS

- A. **Traffic Control:** Maintain access for vehicular and pedestrian traffic as required.

PART 2 - PRODUCTS

2.1 FORMS

- A. **Form Materials:** Forms for exposed concrete wall surfaces shall be faced with smooth tempered masonite or plastic coated forms of as large a dimension as possible as approved by the owner's representative. Elsewhere, the forms shall be constructed of plywood or approved patented form boards with plywood facings and having as large a unit dimension as possible. Studs for wall forms shall be of 2x4 nominal size SIE dimension stock spaced not farther apart than 16 inches on center. The board shall be driven up tight and each board secured to each support with not less than two 6d box nails. Plywood shall be solidly backed to preclude buckling and bulging between supports. Forms for concrete slabs on grade may be two inch thick material of sufficient width to avoid exposure of rough concrete, in finished work. Use flexible or curved forms for curves of a radius 100 feet (30.5 m) or less.

- A. Form-Release Agent: Commercially formulated form-release agent with a maximum of 350 g/L volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- B. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60 (Grade 420). Cut bars true to length with ends square and free of burrs.
- C. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60 (Grade 420), plain steel bars.
- D. Tie Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
 - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer coated wire bar supports.
- F. Epoxy Repair Coating: Liquid two-part epoxy repair coating, compatible with epoxy coating on reinforcement.

2.3 CONCRETE MATERIALS

- A. General: Use the same brand and type of cementitious material from the same manufacturer throughout the Project.
- B. Portland Cement: ASTM C 150, Type I or II.
 - 1. Fly Ash: ASTM C 618, Class F or C.
- C. Aggregate: ASTM C 33, uniformly graded, from a single source with documented service record data of at least 10 years' satisfactory service in similar pavement applications and service conditions, with coarse aggregate as follows:
 - 1. Maximum Aggregate Size: #2B.

Local aggregates not complying with ASTM C 33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to Owner's representative.

- D. Water: ASTM C 94.

2.4 ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures.
- B. Air-Entraining Admixture: ASTM C 260.
- C. Water-Reducing Admixture: ASTM C 494, Type A.
- D. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
- E. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
- F. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. White Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B.
- E. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Clear Waterborne Membrane-Forming Curing Compound:
 - a. AH Curing Compound #2 DR WB; Anti-Hydro International, Inc.
 - b. Aqua Resin Cure; Burke Group, LLC (The).
 - c. Safe-Cure Clear; ChemMasters.
 - d. W.B. Resin Cure; Conspec Marketing & Manufacturing Co., Inc.
 - e. Day Chem Rez Cure (J-11-W); Dayton Superior Corporation.
 - f. Nitocure S; Fosroc.
 - g. Aqua Kure-Clear; Lambert Corporation.
 - h. L&M Cure R; L&M Construction Chemicals, Inc.
 - i. 1100 Clear; W. R. Meadows, Inc.
 - j. Resi-Chem Clear Cure; Symons Corporation.

- k. Horncure 100; Tamms Industries Co., Div. of LaPorte Construction Chemicals North America, Inc.
- l. Hydro Cure; Unitex.

2.6 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.
- B. Wheel Stops: Precast, air-entrained concrete; 2500-psi (17.2-MPa) minimum compressive strength; approximately 6 inches (150 mm) high, 9 inches (225 mm) wide, and 84 inches (2130 mm) long. Provide chamfered corners and drainage slots on underside, and provide holes for dowel-anchoring to substrate.
 - 1. Dowels: Galvanized steel, diameter of 3/4 inch (19 mm), minimum length 10 inches (254 mm).
- C. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery with emery aggregate containing not less than 50 percent aluminum oxide and not less than 25 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
- D. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.7 CONCRETE MIXES

- A. Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
- B. Proportion mixes to provide concrete with the following properties:
 - 1. Compressive Strength (28 Days): 4000 psi (20.7 MPa).
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 - 3. Slump Limit: 4 inches (100 mm).
 - 4. Minimum six bag mix.
- C. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals.
- D. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus or minus 1.5 percent:
 - 1. Air Content: 6 percent plus or minus 1 percent for 1-1/2-inch (38-mm) maximum aggregate.

2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form release agent to ensure separation from concrete without damage.

3.3 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendations in CRSI's "Placing Reinforcing Bars" for placing and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.4 JOINTS

- A. General: Construct construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
 - 1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour, unless pavement terminates at isolation joints.
 - 1. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
 - 2. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
 - 1. Locate expansion joints at intervals of 50 feet (15.25 m), unless otherwise indicated.
 - 2. Extend joint fillers full width and depth of joint.
 - 3. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 - 4. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 - 5. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groover tool to the following radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
 - a. Radius: 3/8 inch (10 mm).
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
- E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to the following radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.
 - 1. Radius: 3/8 inch (10 mm).

3.5 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.

- D. Comply with requirements and with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery, at Project site, or during placement.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- H. Place concrete in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.
 - 1. Remove and replace portions of bottom layer of concrete that have been placed more than 15 minutes without being covered by top layer, or use bonding agent if approved by Architect.
- I. Screed pavement surfaces with a straightedge and strike off. Commence initial floating using bull floats or darbies to form an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading dry-shake surface treatments.
- J. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.
- K. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.
- L. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture

temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.

2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

M. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F (32 deg C). Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover reinforcement steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, reinforcement steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.6 CONCRETE FINISHING

- A. General: Wetting of concrete surfaces during screeding, initial floating, or finishing operations is prohibited.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots, and fill low spots. Refloat surface immediately to uniform granular texture.
 1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.7 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and follow recommendations in ACI 305R for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.

- D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3.8 PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch (6 mm).
2. Thickness: Plus 3/8 inch (9 mm), minus 1/4 inch (6 mm).
3. Surface: Gap below 10-foot- (3-m-) long, unlevelled straightedge not to exceed 1/4 inch (6 mm).
4. Joint Spacing: 3 inches (75 mm).
5. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
6. Joint Width: Plus 1/8 inch (3 mm), no minus.

3.9 WHEEL STOPS

- A. Securely attach wheel stops into pavement with not less than two galvanized steel dowels embedded in holes cast into wheel stops. Firmly bond each dowel to wheel stop and to pavement. Extend upper portion of dowel 5 inches (125 mm) into wheel stop and lower portion a minimum of 5 inches (125 mm) into pavement.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.
- B. Testing Services: Testing shall be performed according to the following requirements:
1. Sampling Fresh Concrete: Representative samples of fresh concrete shall be obtained according to ASTM C 172, except modified for slump to comply with ASTM C 94.
 2. Slump: ASTM C 143; one test at point of placement for each compressive-strength test, but not less than one test for each day's pour of each type of concrete. Additional tests will be required when concrete consistency changes.
 3. Air Content: ASTM C 231, pressure method; one test for each compressive-strength test, but not less than one test for each day's pour of each type of air-entrained concrete.

4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.
5. Compression Test Specimens: ASTM C 31/C 31M; one set of four standard cylinders for each compressive-strength test, unless otherwise indicated. Cylinders shall be molded and stored for laboratory-cured test specimens unless field-cured test specimens are required.
6. Compressive-Strength Tests: ASTM C 39; one set for each day's pour of each concrete class exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m). One specimen shall be tested at 7 days and two specimens at 28 days; one specimen shall be retained in reserve for later testing if required.
7. When frequency of testing will provide fewer than five compressive-strength tests for a given class of concrete, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
8. When total quantity of a given class of concrete is less than 50 cu. yd. (38 cu. m), Architect may waive compressive-strength testing if adequate evidence of satisfactory strength is provided.
9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, current operations shall be evaluated and corrective procedures shall be provided for protecting and curing in-place concrete.
10. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive compressive-strength test results equal or exceed specified compressive strength and no individual compressive-strength test result falls below specified compressive strength by more than 500 psi (3.4 MPa).

- C. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch in pavement, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as the sole basis for approval or rejection.
- E. Additional Tests: Testing agency shall make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

3.11 REPAIRS AND PROTECTION

- A. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet requirements in this Section.
- B. Drill test cores where directed by Architect when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.

- C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 02751

SECTION 02821 - CHAIN-LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Chain-Link Fences: Industrial.
 - 2. Gates: swing.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations, components, materials, dimensions, sizes, weights, and finishes of components. Include plans, gate elevations, sections, details of post anchorage, attachment, bracing, and other required installation and operational clearances.

1.3 QUALITY ASSURANCE

- A. UL Standard: Provide gate operators that comply with UL 325.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

- A. General: 8'-0" high on 24" high concrete wall at mechanical yard; match existing height at Stadium / Parking Lot transition. Comply with ASTM A 392, CLFMI CLF 2445, and requirements indicated below:
 - 1. Steel Wire Fabric: Polymer-coated wire with a diameter of 0.192 inch (at Mechanical Yard; galvanized / zinc-coated at Stadium / Parking Lot) .
 - a. Mesh Size: 2 inches (50 mm).
 - b. Metallic (Zinc) Coating: ASTM A 392, Type II.
 - c. Polymer Coating: ASTM D 668, Class 1 over metallic-coated steel wire.
 - 1) Color: Black, complying with ASTM F 934.
 - 2. Selvage: Knuckled at both selvages.

2.2 INDUSTRIAL FENCE FRAMING

- A. Posts and Rails: Comply with ASTM F 1043 for framing, ASTM F 1083 for Group IC round pipe, and the following:
 - 1. Group: IA, round steel pipe, Schedule 40.
 - 2. Fence Height: 10'-0" at Mechanical Yard; match existing height at Parking Lot / Stadium transition.
 - 3. Strength Requirement: Heavy industrial according to ASTM F 1043.
 - 4. Coating for Steel Framing:
 - a. Metallic coating.

2.3 INDUSTRIAL SWING GATES

- A. General: Comply with ASTM F 900 for double swing gate types.
 - 1. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F 1083 and ASTM F 1043 for materials and protective coatings.
- B. Frames and Bracing: Fabricate members from round, galvanized steel tubing with outside dimension and weight according to ASTM F 900 and the following:
 - 1. Gate Fabric Height: 2 inches (50 mm) less than adjacent fence height.
 - 2. Leaf Width: 36 inches (914 mm).
 - 3. Frame Members:
 - a. Tubular Steel: 2 inches (50 mm) rectangular.
- C. Frame Corner Construction:
 - 1. Welded or assembled with corner fittings.
- D. Hardware: Latches permitting operation from both sides of gate, hinges, and keepers for each gate leaf more than 5 feet wide. Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.

2.4 FITTINGS

- A. General: Comply with ASTM F 626.
- B. Finish:
 - 1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. zinc.

2.5 PRIVACY SLATS

- A. Material: PVC, UV-light stabilized.

- B. Color: black.

2.6 CAST-IN-PLACE CONCRETE

- A. Materials: Portland cement complying with ASTM C 150, Type I aggregates complying with ASTM C 33, and potable water.
 - 1. Concrete Mixes: Normal-weight concrete with not less than 3000-psi compressive strength (28 days), 3-inch slump, and 1-inch maximum size aggregate.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install chain-link fencing to comply with ASTM F 567 and more stringent requirements specified.
- B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
- D. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment.
- E. Line Posts: Space line posts uniformly at 10 feet (3 m) o.c.
- F. Top Rail: Install according to ASTM F 567.
- G. Bottom Rails: Install, spanning between posts.
- H. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 2 inches (50 mm) between finish grade or surface and bottom selvage, unless otherwise indicated.
- I. Tie Wires: Attach wire per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.
- J. Privacy Slats: Install slats in direction indicated, securely locked in place.

3.2 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

END OF SECTION 02821

SECTION 03301 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material.
- B. Form-Facing Panels for architectural finishes: Steel, glass-fiber-reinforced plastic, or other approved nonabsorptive panel materials that will provide continuous, true, and smooth architectural concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Epoxy-Coated Reinforcing Bars: ASTM A 775, epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.
- D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I/II. Supplement with the following:

- a. Fly Ash: ASTM C 618, Class C or F.

- B. Normal-Weight Aggregates: ASTM C 33, graded, 1-inch nominal maximum coarse-aggregate size.
 - C. Water: ASTM C 94/C 94M and potable.
 - D. Air-Entraining Admixture: ASTM C 260.
 - E. Synthetic Fiber: fibrillated polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches long.

2.4 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

2.5 CONCRETE MIXTURES

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - B. Definitions of Mix Properties:
 1. Concrete Compressive Strength is the compressive strength at 28 days as tested per ASTM C39.
 2. Slump Specified is maximum, not to exceed, tested in accordance with ASTM C143.
 3. Air Content is by volume at point of placement and shall be plus or minus 1.5 percent that specified.
 4. Water/Cementitious Materials Ratio is specified by weight.
 5. Drying Shrinkage Limit is percentage change in length after 21 days of drying when tested per ASTM C157 with 4 inch x 4 inch x 11 inch specimen moist cured 7 days prior to drying.
 - C. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 1. Fly Ash: 25 percent.
 2. Combined Fly Ash and Pozzolan: 25 percent.
 - D. Admixtures: Use admixtures according to manufacturers written instructions.
 1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

E. Air Content:

1. Provide 6 percent air content in all exterior concrete and concrete exposed to freeze thaw cycles.
2. Provide 3 percent air content in all building concrete except for footings, mat foundations and grade beams unless noted otherwise.
3. Do not allow air content of troweled finished floors to exceed 3 percent unless noted otherwise. When the air content of a trowel finished floor slab exceeds 3%; there is an increased risk for delaminations and blistering to occur. When this situation is present as in lightweight concrete, the contractor shall pay special attention to the finishing procedures to help minimize such risks. Refer to ACI 302.1R-96 "Guide for Concrete Floor and Slab Construction" for proper finishing guidelines.
4. The contractor shall be responsible for repair and/or replacement of concrete slabs with surface imperfections caused by improper finishing techniques.

F. Continuous and Spread Footings:

1. Minimum Compressive Strength, $f'_c = 3000$.
2. Maximum Water/Cementitious Materials Ratio: 0.50.
3. Slump Limit: 4 inches.
4. Maximum Coarse Aggregate Size: 1.1/2 inch.

G. Grade Beams:

1. Minimum Compressive Strength, $f'_c = 4000$ psi.
2. Maximum Water/Cementitious Materials Ratio: 0.45.
3. Slump Limit: 4 inches.
4. Maximum Coarse Aggregate Size: 1.1/2 inch.

H. Slabs on Grade:

1. Minimum Compressive Strength, $f'_c = 3000$ psi at 28 days tested per ASTM C39.
2. Maximum Water Cementitious Materials Ratio: 0.45.
3. Slump Limit: 4 inches.
4. Maximum Coarse Aggregate Size: 1 inch.
5. Drying Shrinkage Limit: 0.045 percent.

I. Walls and Piers:

1. Minimum Compressive Strength, $f'_c = 4000$ psi.
2. Maximum Water/Cementitious Materials Ratio: 0.45.
3. Slump Limit: 4 inches, 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture.
4. Maximum Coarse Aggregate Size: 1 inch.
5. Drying Shrinkage Limit: 0.045 percent.

2.6 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.2 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

3.3 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness.

3.4 FINISHING FLOORS AND SLABS

- A. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
- B. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

3.5 SITE CONCRETE, INCLUDING RETAINING WALLS, RAMPS, CURBS, STAIRS

- A. Architectural Concrete Finish: All concrete surfaces exposed to view shall have a smooth architectural finish. Match Architect's design reference sample, to satisfaction of Architect.

3.6 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Cure concrete according to ACI 308.1.

3.7 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
 - 1. Testing Services: Tests shall be performed according to ACI 301.

END OF SECTION 03300

SECTION 04810 - UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes unit masonry assemblies consisting of the following:
 - 1. Face brick.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for each type and color of exposed masonry units and colored mortars.

PART 2 - PRODUCTS

2.1 COLORS, TEXTURES, AND PATTERNS

- A. Exposed Masonry Units: Match sample.

2.2 BRICK

- A. General: Provide shapes indicated and as follows:
 - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
- B. Face Brick: ASTM C 216, Grade MW or SW, Type FBX.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3000 psi (20.7 MPa).
 - 2. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
 - 3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
 - 4. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet.
 - 5. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.

2.3 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction.
- B. Hydrated Lime: ASTM C 207, Type S.

2.4 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
- B. Masonry Joint Reinforcement: ASTM A 951; mill galvanized, carbon-steel wire for interior walls and hot-dip galvanized, carbon-steel wire for exterior walls.

2.5 TIES AND ANCHORS

- A. Materials:
 - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153/A 153M, Class B-2 coating.
- B. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.
 - 1. Wire: Fabricate from 1/4-inch- diameter, hot-dip galvanized steel wire.
- C. Adjustable Masonry-Veneer Anchors
 - 1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
 - a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
 - b. Capable of spanning air spaces up to 6 1/2".

2.6 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing, where flashing is exposed or partly exposed and where indicated, complying with Division 7 Section "Sheet Metal Flashing and Trim."
 - 1. Metal Drip Edges: Fabricate from stainless steel. Extend at least 3 inches (75 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees.
 - 2. Metal Flashing Terminations: Fabricate from stainless steel. Extend at least 3 inches (75 mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and down into joint 3/8 inch (10 mm) to form a stop for retaining sealant backer rod.

B. Flexible Flashing: For flashing not exposed to the exterior, use one of the following, unless otherwise indicated:

1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch.
2. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D 4637, 0.040 inch thick.

2.7 MISCELLANEOUS MASONRY ACCESSORIES

A. Weep/Vent Products: Use one of the following, unless otherwise indicated:

1. Rectangular Plastic Weep/Vent Tubing: Clear butyrate, 3/8 by 1-1/2 by 3-1/2 long.
2. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
3. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe; in color selected from manufacturer's standard.

B. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

2.8 FIELD QUALITY CONTROL

A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.

END OF SECTION 04810

SECTION 05400 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Interior load-bearing wall framing.
 - 2. Ceiling joist framing.

1.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Loads: As indicated on drawings.
 - 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height.
 - b. Ceiling Joist Framing: Vertical deflection of 1/360 of the span.
 - 3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).
 - 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of 3/4 inch (19 mm).

1.3 SUBMITTALS

- A. Product Data: For each type of cold-formed metal framing product and accessory indicated.
- B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining Work.
 - 1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed cold-formed metal framing similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

PART 2 - PRODUCTS

2.1 LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, complying with ASTM C 955, and as follows:
 - 1. Minimum Uncoated-Steel Thickness: 0.0428 inch (1.09 mm).
 - 2. Flange Width: 1-5/8 inches (41 mm).
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, complying with ASTM C 955, and as follows:
 - 1. Minimum Uncoated-Steel Thickness: Matching steel studs.
 - 2. Flange Width: 1-1/4 inches (32 mm).

2.2 CEILING JOIST FRAMING

- A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, unpunched, with stiffened flanges, complying with ASTM C 955, and as follows:
 - 1. Minimum Uncoated-Steel Thickness: 0.0428 inch (1.09 mm).
 - 2. Flange Width: 2 inches (51 mm), minimum.

2.3 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories of the same material and finish used for framing members, with a minimum yield strength of 33,000 psi (230 MPa).

2.4 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123.
- B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel headless, hooked bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
- D. Welding Electrodes: Comply with AWS standards.

2.5 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A 780.
- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

2.6 FABRICATION

- A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to manufacturer's written recommendations and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed metal framing members by welding. Wire tying of framing members is not permitted. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - 4. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
 - 5. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of **1/8 inch in 10 feet (1:960)** and as follows:

1. Spacing: Space individual framing members no more than plus or minus **1/8 inch (3 mm)** from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of **1/8 inch (3 mm)**.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed metal framing according to ASTM C 1007, unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
- D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to manufacturer's written recommendations and requirements in this Section.
 1. Cut framing members by sawing or shearing; do not torch cut.
 2. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.
- E. Install framing members in one-piece lengths, unless splice connections are indicated for track or tension members.
- F. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
- G. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of **1/8 inch in 10 feet**.

3.2 LOAD-BEARING WALL INSTALLATION

- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
 1. Anchor Spacing: As shown on Shop Drawings.
- B. Squarely seat studs against webs of top and bottom tracks. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
 1. Stud Spacing: As indicated.

- C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar configurations.
- D. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- E. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.
- F. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
 - 1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings.
 - 2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- G. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
- H. Install horizontal bridging in stud system to the dimension indicated on Shop Drawings apart. Fasten at each stud intersection.
- I. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.3 JOIST INSTALLATION

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
 - 1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm).
 - 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.
- C. Space joists not more than 2 inches (51 mm) from abutting walls, and as follows:
 - 1. Joist Spacing: As indicated.
- D. Frame openings with built-up joist headers consisting of joist and joist track, nesting joists, or another combination of connected joists if indicated.

- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated on Shop Drawings.
 - 1. Install web stiffeners to transfer axial loads of walls above.
- F. Install bridging at each end of joists and at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:
 - 1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to bottom flange of joists.
 - 2. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
- G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.4 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing agency to perform field quality-control testing.
- B. Field and shop welds will be subject to inspection and testing.
- C. Remove and replace Work that does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

3.5 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: Wire brush, clean, and paint scarred areas, welds, and rust spots on fabricated and installed prime-painted, cold-formed metal framing. Paint framing surfaces with same type of shop paint used on adjacent surfaces.
- C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05400

SECTION 06100 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Wood blocking.
 - 2. Wood cants.
 - 3. Wood nailers.
 - 4. Wood sheathing.
 - 5. Plywood backing panels.

1.2 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product indicated.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that materials comply with requirements.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Provide dressed lumber, S4S, unless otherwise indicated.
 - 3. Provide dry lumber with 15 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWPA C2 (lumber) AWPA C9 (plywood), except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).
- B. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
- C. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing members less than 18 inches (460 mm) above grade.
4. Wood floor plates that are installed over concrete slabs directly in contact with earth.

2.3 DIMENSION LUMBER

- A. General: Of grades indicated according to the American Lumber Standards Committee National Grading Rule provisions of the grading agency indicated.
- B. Framing: No. 2 grade or better as indicated, and the following species:
 1. Douglas fir-larch, Douglas fir-larch (north), or Douglas fir-south; NLGA, WCLIB, or WWPA.

2.4 SHEATHING

- A. Plywood Wall Sheathing: Exterior, Structural I sheathing.
- B. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/C 1177M.
 1. Product: Subject to compliance with requirements, provide "Dens-Glass Gold" by G-P Gypsum Corp.
 2. Type and Thickness: Type X, 5/8 inch (15.9 mm) thick.

2.5 PLYWOOD BACKING PANELS

- A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2 inch (12.7 mm) thick.
- B. Provide 3/4" thick plywood backing panels at locations for wall-mounted equipment including, but not limited to: grab bars, sinks, toilets, drinking fountains, wall-mounted cabinets, countertops, etc.

END OF SECTION 06100

SECTION 08712 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Commercial door hardware for the following:
 - a. Swinging doors.

1.2 SUBMITTALS

- A. Product Data: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Warranty: Special warranty specified in this Section.
 - 1. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.
 - 1. Installer's responsibilities include supplying and installing door hardware, and providing a qualified Architectural Hardware Consultant available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
- B. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.
 - 1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of operators and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: Three years from date of Substantial Completion, except as follows:
 - a. Exit Devices: Two years from date of Substantial Completion.
 - b. Manual Closers: 10 years from date of Substantial Completion.

1.5 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, provide **twelve** months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door hardware operation. Provide parts and supplies same as those used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with Snow College campus standards. Bob Oliver and Snow College Facilities personnel will review all proposed hardware for compliance with standards.
- B. Components of door hardware for each door location are listed on the architectural drawings.
- C. Panic devices and locks to comply with Snow College standards and be approved by the State Fire Marshal.

2.2 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.
- C. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 2. Steel Machine or Wood Screws: For the following fire-rated applications:
 - a. Mortise hinges to doors.
 - b. Strike plates to frames.
 - c. Closers to doors and frames.
 3. Steel Through Bolts: For the following fire-rated applications unless door blocking is provided:
 - a. Surface hinges to doors.
 - b. Closers to doors and frames.
 - c. Surface-mounted exit devices.
 4. Spacers or Sex Bolts: For through bolting of hollow-metal doors.

2.3 FINISHES

- A. Standard: BHMA A156.18, as indicated in door hardware sets.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: Comply with DHI A115 Series.
 - 1. Surface-Applied Door Hardware: Drill and tap doors and frames according to ANSI A250.6.
- B. Wood Doors: Comply with DHI A115-W Series.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Custom Steel Doors and Frames: DHI's "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames."
 - 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

3.4 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
 - 2. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.
- B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer shall examine and readjust, including adjusting operating forces, each item of door hardware as necessary to ensure function of doors, and door hardware.

3.5 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

END OF SECTION 08712

SECTION 09260 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Interior gypsum wallboard.
 - 2. Non-load-bearing steel framing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
 - 2. Products: Subject to compliance with requirements, provide one of the products specified.
 - 3. Product: Subject to compliance with requirements, provide the product specified.

2.2 STEEL FRAMING

- A. Steel Framing, General: Comply with ASTM C 754 for conditions indicated.
- B. Suspended Ceiling and Soffit Framing:
 - 1. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch-diameter wire, or double strand of 0.0475-inch-diameter wire.
 - 2. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.
 - 3. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of 0.0538 inch, a minimum 1/2-inch-wide flange, and in depth indicated.
 - 4. Furring Channels (Furring Members):
 - a. Cold Rolled Channels: 0.0538-inch bare steel thickness, with minimum 1/2-inch-wide flange, 3/4 inch deep.
 - b. Steel Studs: ASTM C 645, in depth indicated.
 - 1) Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
 - c. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22.2 mm) deep.

- 1) Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
- C. Grid Suspension System for Interior Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
1. Available Products:
 - a. Armstrong World Industries, Inc.; Furring Systems/Drywall.
 - b. Chicago Metallic Corporation; Drywall Furring 640, Drywall Furring 660 System.
 - c. USG Interiors, Inc.; Drywall Suspension System.
- D. Partition and Soffit Framing:
1. Steel Studs and Runners: ASTM C 645, in depth indicated.
 - a. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm), 0.027 inch (0.7 mm) and 0.0312 inch (0.79 mm) as required by span or length according to manufacturers' recommendations.
 2. Deep-Leg Deflection Track: ASTM C 645 top runner with 2-inch-deep flanges.
 3. Cold-Rolled Channel Bridging: 0.0538-inch bare steel thickness, with minimum 1/2-inch-wide flange, and in depth indicated.
 - a. Clip Angle: 1-1/2 by 1-1/2 inch, 0.068-inch-thick, galvanized steel.
 4. Hat-Shaped, Rigid Furring Channels: ASTM C 645, in depth indicated.
 - a. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
 5. Cold-Rolled Furring Channels: **0.0538-inch (1.37-mm)** bare steel thickness, with minimum **1/2-inch- (12.7-mm-)** wide flange, and in depth indicated.
 - a. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare steel thickness of **0.0312 inch (0.79 mm)**.
 - b. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, **0.0625-inch- (1.59-mm-)** diameter wire, or double strand of **0.0475-inch- (1.21-mm-)** diameter wire.
 6. Z-Shaped Furring: With slotted or nonslotted web, face flange of **1-1/4 inches (31.8 mm)**, wall attachment flange of **7/8 inch (22.2 mm)**, minimum bare metal thickness of **0.0179 inch (0.45 mm)**, and depth required to fit insulation thickness indicated.
 7. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.3 PANEL PRODUCTS

- A. Panel Size, General: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- B. Gypsum Wallboard: ASTM C 36.

1. Regular Type: In thickness indicated and with long edges tapered.
2. Type X: In thickness indicated and with long edges tapered.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Cornerbead: Use at outside corners, unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.
2. Exterior Gypsum Soffit Board: Paper.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, flanges of trim accessories, and fasteners, use drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, drying-type, all-purpose compound.

D. Joint Compound for Exterior Applications:

1. Exterior Gypsum Soffit Board: Use setting-type taping and setting-type, sandable topping compounds.
2. Glass-Mat Gypsum Sheathing Board: As recommended by manufacturer.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

C. Isolation Strip at Exterior Walls:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.

D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

PART 3 - EXECUTION

3.1 NON-LOAD-BEARING STEEL FRAMING INSTALLATION

A. General: Comply with ASTM C 754, and ASTM C 840 requirements that apply to framing installation.

B. Suspended Ceiling and Soffit Framing:

1. Suspend ceiling hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
3. Attach hangers to structural members. Do not support ceilings from or attach hangers to permanent metal forms, steel deck tabs, steel roof decks, ducts, pipes, or conduit.
4. Screw furring to wood framing.
5. Wire-tie furring channels to supports, as required to comply with requirements for assemblies indicated.
6. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

C. Partition and Soffit Framing:

1. Where studs are installed directly against exterior walls, install isolation strip between studs and wall.
2. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
3. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

- a. Install two studs at each jamb, unless otherwise indicated.
 - b. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
4. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
- D. Z-Furring Members: Erect insulation vertically and hold in place with Z-furring members.
- E. Polyethylene Vapor Retarder: Install to comply with requirements specified in Division 7 Section "Building Insulation."

3.2 PANEL PRODUCT INSTALLATION

- A. Gypsum Board: Comply with ASTM C 840 and GA-216.
 1. Space screws a maximum of 12 inches (304.8 mm) o.c. for vertical applications.
 2. Space fasteners in panels that are tile substrates a maximum of 8 inches (203.2 mm) o.c.
 3. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
 4. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing), unless otherwise indicated, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of board.
 5. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 6. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.3 FINISHING

- A. Installing Trim Accessories: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Finishing Gypsum Board Panels: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration.
 1. Prefill open joints, beveled edges and damaged surface areas.
 2. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
 3. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

- C. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
1. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.
 2. Level 5: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat of joint compound over entire surface where indicated.

END OF SECTION 09260

SECTION 09511 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes ceilings consisting of acoustical panels and exposed suspension systems.

1.3 SUBMITTALS

- A. Product Data: For each type of product specified.
- B. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
 - 1. Ceiling suspension system members.
 - 2. Method of attaching suspension system hangers to building structure.
 - 3. Ceiling-mounted items including light fixtures; air outlets and inlets; speakers; sprinklers; and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.
 - 4. Minimum Drawing Scale: 1/8 inch = 1 foot (1:96).
- C. Samples for Verification: Full-size units of each type of ceiling assembly indicated; in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics.
 - 1. 6-inch- (150-mm-) square samples of each acoustical panel type, pattern, and color.
 - 2. Set of 12-inch- (300-mm-) long samples of exposed suspension system members, including moldings, for each color and system type required.
- D. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- E. Product Test Reports: Indicate compliance of acoustical panel ceilings and components with requirements based on comprehensive testing of current products.
- F. Research/Evaluation Reports: Evidence of acoustical panel ceiling's and components' compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

- A. **Installer Qualifications:** Engage an experienced installer who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. **Source Limitations for Ceiling Units:** Obtain each acoustical ceiling panel from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- C. **Source Limitations for Suspension System:** Obtain each suspension system from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
 - 1. Obtain both acoustical ceiling panels and suspension system from the same manufacturer.
- D. **Fire-Test-Response Characteristics:** Provide acoustical panel ceilings that comply with the following requirements:
 - 1. Fire-response tests were performed by UL, ITS/Warnock Hersey, or another independent testing and inspecting agency that is acceptable to authorities having jurisdiction and that performs testing and follow-up services.
 - 2. Surface-burning characteristics of acoustical panels comply with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84.
 - 3. Products are identified with appropriate markings of applicable testing and inspecting agency.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS

- A. **Environmental Limitations:** Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Acoustical Ceiling Units: Full-size units equal to 2.0 percent of amount installed.
 - 2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated for each designation in the Acoustical Panel Ceiling Schedule at the end of Part 3.

2.2 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
 - 1. Mounting Method for Measuring Noise Reduction Coefficient: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.
- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
 - 1. Where appearance characteristics of acoustical panels are indicated by referencing ASTM E 1264 pattern designations and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range of products that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.
- C. Panel Characteristics: Comply with requirements indicated in the Acoustical Panel Ceiling Schedule at the end of Part 3, including those referencing ASTM E 1264 classifications.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements.
- B. Metal Suspension System Characteristics: Comply with requirements indicated in the Acoustical Panel Ceiling Schedule at the end of Part 3.

- C. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
- D. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.
- E. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, Direct Hung) will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.
- F. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- G. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- H. Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.
- I. Hold-Down Clips for Non-Fire-Resistance-Rated Ceilings: For interior ceilings consisting of acoustical panels weighing less than 1 lb/sq. ft. (4.88 kg/sq. m), provide hold-down clips spaced 24 inches (610 mm) o.c. on all cross tees.
- J. Impact Clips: Typical, unless noted otherwise, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

2.4 ACOUSTICAL SEALANT

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following requirements:
 - 1. Product is effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- B. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.
- C. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Acoustical Sealant for Exposed and Concealed Joints:
 - a. PL Acoustical Sealant; Chemrex, Inc., Contech Brands.
 - b. AC-20 FTR Acoustical and Insulation Sealant; Pecora Corp.

- c. SHEETROCK Acoustical Sealant; United States Gypsum Co.
- 2. Acoustical Sealant for Concealed Joints:
 - a. BA-98; Pecora Corp.
 - b. Tremco Acoustical Sealant; Tremco, Inc.

2.5 MISCELLANEOUS MATERIALS

- A. Tile adhesives: Type recommended by tile manufacturer, bearing UL label for Class 0-25 flamespread.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage, and other conditions affecting performance of acoustical panel ceilings.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other ceiling anchors whose installation is specified in other Sections.
 - 1. Furnish cast-in-place anchors and similar devices to other trades for installation well in advance of time needed for coordinating other work.
 - 2. Test substrates to verify moisture level is below tile manufacturer's recommended limits before installing adhesive applied tile.
- B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with publications referenced below per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
 - 1. Standard for Ceiling Suspension System Installations: Comply with ASTM C 636.
 - 2. U.B.C.'s "Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings": U.B.C. Standard 25-2.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
 5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure; that are appropriate for substrate; and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, powder-actuated fasteners, or drilled-in anchors that extend through forms into concrete.
 8. Do not attach hangers to steel deck tabs.
 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 8 inches (200 mm) from ends of each member.
 11. Wire shall not be kinked and tails shall be cut.
 12. Provide separate wired to hang light fixtures.
 13. Architect to dimension cuts to border, do not balance layout.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m). Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fitted accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
 - 1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 - 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
 - 3. Paint cut panel edges remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 - 4. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated or required.
- G. Provide one extra box of each acoustical ceiling panels for owner.

3.5 ACOUSTICAL PANEL CEILING SCHEDULE

- A. White, Acoustical Panels for Acoustical Panel Ceiling ACT-1: Where this designation is indicated, provide [fire-resistance-rated where noted] acoustical panels, complying with the following:
 - 1. Products:
 - a. USG Interiors, Radar 2110.
 - 2. Color: White.
 - 3. Light Reflectance Coefficient: LR 0.84
 - 4. Noise Reduction Coefficient: NRC 0.55
 - 5. Ceiling Attenuation Class: CAC 35
 - 6. Edge Detail: SQ
 - 7. Thickness: 5/8 inch.
 - 8. Size: 2' x 2'
 - 9. Application: Where indicated.
 - 10. Suspension System: Armstrong Prelude XL 15/16" exposed tee system. Edge trim to be install with BERC2 clips.

3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09511

SECTION 09651 - RESILIENT FLOOR TILE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Vinyl composition tile (VCT).

1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Samples: Full-size units of each color and pattern of resilient floor tile required.

1.3 PROJECT CONDITIONS

- A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation, during installation and 48 hours after installation.
- B. After post-installation period, maintain temperatures within range recommended by manufacturer.
- C. Close spaces to traffic during floor covering installation.
- D. Close spaces to traffic for 48 hours after floor covering installation.
- E. Install resilient products after other finishing operations, including painting, have been completed.

1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

PART 2 - PRODUCTS

2.1 VINYL COMPOSITION TILE

- A. Vinyl Composition Tile (VCT): ASTM F 1066.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated on the drawings.
- B. Color and Pattern: as indicated on Drawings.
- C. Thickness: 0.125 inch (3.2 mm).
- D. Size: 12 by 12 inches (305 by 305 mm).
- E. Fire-Test-Response Characteristics:
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm per ASTM E 648.

2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
- C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
- C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

- E. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
 - 1. Do not install resilient products until they are same temperature as space where they are to be installed.
- F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - 1. Lay tiles square with room axis.
- B. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles with grain direction alternating in adjacent tiles (basket-weave pattern).
- C. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, etc.
- D. Extend tiles into toe spaces, door reveals, closets, and similar openings.
- E. Install tiles on covers for telephone and electrical ducts and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of tile installed on covers. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- F. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- G. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- H. Protect resilient products from marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

END OF SECTION 09651

SECTION 09680 - CARPET

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes tufted carpet.

1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Samples: For each carpet and exposed accessory and for each color and pattern required.
- C. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install carpet until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by manufacturer.

1.5 WARRANTY

- A. Carpet Warranty: Manufacturer's standard form in which manufacturer agrees to replace carpet that does not comply with requirements or that fails within **10 years** from date of Substantial Completion. Warranty does not include deterioration or failure of carpet from unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delamination.

PART 2 - PRODUCTS

2.1 CARPET

- A. Products: Subject to compliance with requirements, provide the following:

1. Product as indicated on Drawings in colors, patterns and performance characteristics associated with each Product.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with CRI 104, Section 8, "Direct Glue-Down."
- B. Maintain uniformity of carpet direction and lay of pile. At doorways, locate seams as indicated on drawings. Bind or seal cut edges as recommended by carpet manufacturer.
- C. Install pattern parallel to walls and borders, or as indicated on drawings.

END OF SECTION 09680

SECTION 09912 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes surface preparation and field painting of the following:
 - 1. Exposed exterior items and surfaces.
 - 2. Exposed interior items and surfaces.
 - 3. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
 - 4. Exterior masonry sealer.
- B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
- C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels unless specifically noted otherwise.
 - 1. Prefinished items include the following factory-finished components:
 - a. Architectural woodwork and casework.
 - b. Acoustical wall panels.
 - c. Metal toilet enclosures.
 - d. Metal lockers.
 - e. Finished mechanical and electrical equipment-electrical panels exposed in walls other than storage rooms, electric room, mechanical room or other utility type room may not be painted, all others to match wall surface color.
 - f. Light fixtures.
 - g. Distribution cabinets.
 - 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
 - a. Foundation spaces.
 - b. Furred areas.
 - c. Ceiling plenums.

- d. Utility tunnels.
 - e. Pipe spaces.
 - f. Duct shafts.
 - g. Elevator shafts.
- 3. Finished metal surfaces include the following:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - c. Chromium plate.
 - d. Copper.
 - e. Bronze and brass.
- 4. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
- 5. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Related Sections include the following:

- 1. Division 5 Section "Structural Steel" for shop priming structural steel.
- 2. Division 8 Section "Steel Doors and Frames" for shop priming steel doors and frames.
- 3. Division 8 Section "Flush Wood Doors" for prefinished doors.
- 4. Division 9 Section "Gypsum Board Assemblies" for surface preparation for gypsum board.
- 5. Divisions 15 and 16: Painting of mechanical and electrical work is specified in Divisions 15 and 16, respectively.

- E. Reference the Painting and Decorating Contractor's of America (PDCA) Technical Manual as a reference for a "type 1 standard job".
- F. When epoxy or lacquer materials are specified, include a requirement for providing positive ventilation of the spaces, and a requirement that the application be made after 5:00pm on Friday (to allow odors to dissipate over the weekend, or other acceptable time).

1.3 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

- 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
- 2. Eggshell refers to low-sheen finish with a gloss range between 5 and 20 when measured at a 60-degree meter.
- 3. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.

4. Semigloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
5. Full gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

1.4 SUBMITTALS

- A. Product Data: For each paint system specified. Include block fillers and primers.
 1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
 3. Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).
- B. Samples for Verification: Of each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
 1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
 2. Provide a list of materials and applications for each coat of each sample. Label each sample for location and application.
 3. Submit Samples on the following substrates for the Architect's review of color and texture only:
 - a. Concrete: Provide two 4-inch- (100-mm-) square samples for each color and finish.
 - b. Concrete Masonry: Provide two 4-by-8-inch (100-by-200-mm) samples of masonry, with mortar joint in the center, for each finish and color.
 - c. Painted Wood: Provide two 12-inch- (300-mm-) square samples of each color and material on hardboard.
 - d. Stained or Natural Wood: Provide two 4-by-8-inch (100-by-200-mm) samples of natural- or stained-wood finish on actual wood surfaces specified.
 - e. Ferrous Metal: Provide two 4-inch- (100-mm-) square samples of flat metal and two 8-inch- (200-mm-) long samples of solid metal for each color and finish.
 - f. Aniline Wood Dyed wood: Provide two 4-by-8-inch square samples of dyed and finished wood for each color required, on actual wood surfaces specified.
 - g. Gypsum Wallboard: Provide paint draw-downs for each color and finish specified, labeled with paint type (name and number) and Color (name and number).
 - h. Acoustical Speaker Cloth Fabric: Provide a minimum 24 inch by 24 inch piece of fabric painted with specified paint color to match gypsum wallboard Theater "clouds" with acrylic waterbased paint and airsprayed to preserve acoustical transparency.
- C. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project

names and addresses, names and addresses of architects and owners, and other information specified.

- D. The contractor shall submit "as-built" color and material schedule for each substrate and finish system with the project closeout documents, including:

1. Descriptive location (room number, etc.)
2. Manufacturer
3. Paint type (name and number)
4. Color (name and number)

1.5 QUALITY ASSURANCE

- A. **Applicator Qualifications:** Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.
- B. **Source Limitations:** Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.
- C. **Benchmark Samples (Mockups):** Provide a full-coat benchmark finish sample of each type of coating and substrate required on the Project. Comply with procedures specified in PDCA P5. Duplicate finish of approved prepared samples.

1. The Architect will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted.
 - a. **Wall Surfaces:** Provide samples on at least 100 sq. ft. (9 sq. m) of wall surface.
 - b. **Small Areas and Items:** The Architect will designate an item or area as required.
2. After permanent lighting and other environmental services have been activated, apply coatings in this room or to each surface according to the Schedule or as specified. Provide required sheen, color, and texture on each surface.
 - a. After finishes are accepted, the Architect will use the room or surface to evaluate coating systems of a similar nature.
3. Final approval of colors will be from job-applied samples.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
1. Product name or title of material.
 2. Product description (generic classification or binder type).
 3. Manufacturer's stock number and date of manufacture.
 4. Contents by volume, for pigment and vehicle constituents.
 5. Thinning instructions.
 6. Application instructions.

7. Color name and number.
8. VOC content.

- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.
 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.7 PROJECT CONDITIONS

- A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 deg F (10 and 32 deg C).
- B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 and 95 deg F (7.2 and 35 deg C).
- C. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.8 EXTRA MATERIALS

- A. Furnish extra paint materials from the same production run as the materials applied in the quantities described below. Package paint materials in unopened, factory-sealed containers for storage and identify with labels describing contents. Deliver extra materials to the Owner.
 1. Quantity: Furnish the Owner with extra paint materials in the quantities indicated below:
 - a. Exterior, Low-Luster Acrylic Finish: One case of each color applied.
 - b. Exterior, Semigloss Acrylic Enamel: 2 gal. (7.57 L) of each color applied.
 - e. Interior, Low-Luster Acrylic Finish: One case of each color applied.
 - f. Interior, Semigloss Acrylic Enamel: 2 gal. (7.57 L) of each color applied.
 2. Quantity: Furnish the Owner with an additional 5 percent, but not less than 1 gal. (3.785 L) or 1 case, as appropriate, of each material and color applied.

PART 2 - PRODUCTS

2.2 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

- B. **Material Quality:** Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable. Top-of-the-line products for approved manufacturers are:
 - 1. Kwal Howells
 - 2. Sherwin Williams
 - 3. Benjamin Moore
 - 4. ICI paints
 - 5. Columbia Paints
- C. **Colors:** Provide color selections made by the Architect (see finish schedule in drawings).
- D. **Finish:** All surfaces called to be painted are to receive a **smooth** finish application of paint. No textures will be accepted.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. **Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.**
 - 1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 - 2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.
- B. **Coordination of Work:** Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - 1. Notify the Architect about anticipated problems using the materials specified over substrates primed by others.

3.2 PREPARATION

- A. **General:** Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. **Cleaning:** Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.
 - 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
1. Provide barrier coats over incompatible primers or remove and reprime.
 2. Cementitious Materials: Prepare concrete and concrete masonry block, surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
 - b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.
 - c. Clean concrete floors to be sealed with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before sealing.
 3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
 - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and backsides of wood, including cabinets, counters, cases, and paneling.
 - c. When transparent finish is required, backprime with spar varnish.
 - d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on backside.
 - e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
 4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.
 - a. Blast steel surfaces clean as recommended by paint system manufacturer and according to requirements of SSPC-SP 10.
 - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.
 5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

- D. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Paint colors, surface treatments, and finishes are indicated in the schedules.
 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 3. Provide finish coats that are compatible with primers used.
 4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convactor covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
 10. Sand lightly between each succeeding enamel or varnish coat.
 11. The color of each coat shall be slightly varied.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 2. Omit primer on metal surfaces that have been shop primed and touchup painted.

3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
 2. Rollers: Use rollers of carpet, velvet back, or sheep's wool as recommended by the manufacturer for the material and smooth/flat texture required.
 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and smooth/flat texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and in occupied spaces.
- F. Mechanical items to be painted include, but are not limited to, the following:
1. Piping, pipe hangers, and supports.
 2. Heat exchangers.
 3. Tanks.
 4. Ductwork.
 5. Insulation.
 6. Motors and mechanical equipment.
 7. Accessory items.
- G. Electrical items to be painted include, but are not limited to, the following:
1. Conduit and fittings.
 2. Switchgear.
 3. Panelboards.
- H. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
- I. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

- J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- K. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
 - 1. Provide satin finish for final coats.
- L. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
- M. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 FIELD QUALITY CONTROL

- A. The Owner reserves the right to invoke the following test procedure at any time and as often as the Owner deems necessary during the period when paint is being applied:
 - 1. The Owner will engage the services of an independent testing agency to sample the paint material being used. Samples of material delivered to the Project will be taken, identified, sealed, and certified in the presence of the Contractor.
 - 2. The testing agency will perform appropriate tests for the following characteristics as required by the Owner:
 - a. Quantitative material analysis.
 - b. Abrasion resistance.
 - c. Apparent reflectivity.
 - d. Flexibility.
 - e. Washability.
 - f. Absorption.
 - g. Accelerated weathering.
 - h. Dry opacity.
 - i. Accelerated yellowness.
 - j. Recoating.
 - k. Skinning.
 - l. Color retention.
 - m. Alkali and mildew resistance.
 - 3. The Owner may direct the Contractor to stop painting if test results show material being used does not comply with specified requirements. The Contractor shall remove noncomplying paint from the site, pay for testing, and repaint surfaces previously coated with the rejected paint. If necessary, the Contractor may be required to remove rejected

paint from previously painted surfaces if, on repainting with specified paint, the 2 coatings are incompatible.

4. The Owner will preform inspection after each primer and finish coat, prior to application of the succeeding coat.

3.5 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.6 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
 1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.7 EXTERIOR PAINT SCHEDULE (see drawings for colors)

- A. Concrete, and Masonry: The following for finish systems over exterior concrete, and brick masonry surfaces: See Division 7 of this Specifications Manual for water repellant.
- B. Exterior Gypsum Soffit Board, where required and indicated: Provide the following finish systems over exterior gypsum soffit board:
 1. Low-Luster Acrylic Finish: 2 finish coats over a primer.
 - a. Primer: Exterior, alkyd- or alkali-resistant, acrylic-latex primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils (0.038 mm).
 - b. First and Second Coats: Low-luster (eggshell or satin), exterior, acrylic-latex paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.3 mils (0.058 mm).
- C. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
 1. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a rust-inhibitive primer.

- a. Primer: Rust-inhibitive metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.3 mils (0.033 mm).
 - b. First and Second Coats: Semigloss, exterior, acrylic-latex enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils (0.066 mm).
 - D. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated (galvanized) metal surfaces:
 - 1. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a galvanized metal primer.
 - a. Primer: Galvanized metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils (0.031 mm).
 - b. First and Second Coats: Semigloss, exterior, acrylic-latex enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils (0.066 mm).
- 3.8 INTERIOR PAINT SCHEDULE (see drawings for location of finishes and colors)
- A. Concrete Masonry Units: Provide the following finish systems over interior concrete masonry block units:
 - 1. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a block filler.
 - a. Block Filler: High-performance, latex-based, block filler applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 5.0 mils (0.13 mm).
 - b. First and Second Coats: Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils (0.066 mm).
 - B. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
 - 1. Satin or eggshell, Acrylic-Enamel Finish: 2 finish coats over a primer, typical unless noted otherwise.
 - a. Primer: Alkali-resistant, acrylic-latex, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.0 mil (0.025 mm).
 - b. First and Second Coats: Low-luster (eggshell or satin), acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.8 mils (0.071 mm).
 - 2. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a primer, typical in Toilet and Janitor rooms.

- a. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils (0.031 mm).
 - b. First and Second Coats: Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils (0.066 mm).
 3. Water Based Satin Primer:: 2 finish coats.
 - a. First and Second Coats: Satin, acrylic, polymer interior water based primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 3 mils.
 - 1) Rosco: Tough-prime.
- C. Woodwork and Hardboard: Provide the following paint finish systems over new, interior wood surfaces; noted as paint (opaque) finish.
 1. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a wood undercoater.
 - a. Undercoat: Alkyd- or acrylic-latex-based, interior wood undercoater, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils (0.031 mm).
 - b. First and Second Coats: Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils (0.066 mm).
 2. Water Based Satin Primer:
 - a. First and Second Coats: Satin, acrylic polymer, water based primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 3 mils.
- D. Stained and Dyed Woodwork: Provide the following stained finishes over new, interior woodwork:
 1. Alkyd-Based, Satin-Varnish Finish: 2 finish coats of an alkyd-based, clear-satin varnish over a sealer coat and an alkyd-based, interior wood stain. Wipe wood filler before applying stain.
 - a) Filler Coat: Paste-wood filler applied at spreading rate recommended by the manufacturer.
 - b) Stain Coat: Alkyd-based, interior wood stain applied at spreading rate recommended by the manufacturer.
 - c) Sealer Coat: Clear sanding sealer applied at spreading rate recommended by the manufacturer.
 - d) First and Second Finish Coats: Alkyd-based or polyurethane varnish, as recommended by the manufacturer, applied at spreading rate recommended by the manufacturer.

3. Aniline Wood Dye, Satin Varnish Finish: 2 Finish coats of an alkyd-based, clear-satin varnish over Aniline dyed wood. Colors as per Finish Schedule.
- E. Natural-Finish Woodwork: Provide the following natural finishes over new, interior woodwork:
1. Alkyd-Based, Satin-Varnish Finish: 2 finish coats of an alkyd-based, clear-satin varnish over a sanding sealer. Provide wood filler on open-grain wood before applying first varnish coat.
 - a. Filler Coat: Paste-wood filler applied at spreading rate recommended by the manufacturer.
 - b. Sealer Coat: Clear sanding sealer applied at spreading rate recommended by the manufacturer.
 - c. First and Second Finish Coats: Alkyd-based or polyurethane varnish, as recommended by the manufacturer, applied at spreading rate recommended by the manufacturer.
- F. Ferrous Metal: Provide the following finish systems over ferrous metal:
1. Semigloss, Acrylic-Enamel Finish: One finish coat over an enamel undercoater and a primer.
 - a. Primer: Quick-drying, rust-inhibitive, alkyd-based or epoxy-metal primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils (0.038 mm).
 - b. Undercoat: Alkyd, interior enamel undercoat or semigloss, acrylic-latex, interior enamel, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.3 mils (0.033 mm).
 - c. Finish Coat: Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.3 mils (0.033 mm).
- G. Zinc-Coated Metal: Provide the following finish systems over zinc-coated metal:
1. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a primer.
 - a. Primer: Galvanized metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils (0.031 mm).
 - b. First and Second Coats: Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils (0.066 mm).
- H. Concrete Floors: Where indicated on drawings as sealed concrete (SC-1 and SC-2) and beneath any areas called out to receive a walk off mat (WM-1), provide (1) one coat of clear/transparent penetrating epoxy primer/sealer.

1. Product: DUR-A-SHIELD #2 or approved equal.

END OF SECTION 09912

DIVISION 15
MECHANICAL

- 15010 GENERAL REQUIREMENTS
- 15050 BASIC MATERIALS & METHODS
- 15075 MECHANICAL IDENTIFICATION
- 15080 HVAC AND PLUMBING INSULATION
- 15140 DOMESTIC WATER PIPING
- 15151 CONDENSATE DRAIN PIPING
- 15734 COMPUTER ROOM AIR CONDITIONING UNITS
- 15815 METAL DUCTS
- 15855 DIFFUSERS, REGISTERS, AND GRILLES
- 15900 HVAC AND INSTRUMENTATION CONTROLS
- 15950 TESTING, ADJUSTING AND BALANCING

SECTION 15010 - GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL

- A. General Conditions and Division 01 apply to this Division.

1.2 SCOPE

- A. Includes -

1. Furnish all labor, materials, and equipment necessary for the completion of the mechanical and plumbing scope of work.
2. Furnish and install all motors specified in this Division and be responsible for the proper operation of electrical powered equipment furnished by this Division.
3. Furnish exact location of electrical connections and information on motor controls to Division 16.
4. Mechanical Contractor shall obtain the services of independent Test and Balance Agency.
5. Placing the air conditioning, heating, ventilating, and exhaust systems into full operation and continuing their operation during each working day of testing and balancing.
6. Making changes in pulleys, belts, and dampers, or adding dampers, as required for the correct balance as recommended by Balancing Contractor at no additional cost to Owner.
7. Air balance, final adjustment and test run.
8. The satisfactory performance of the completed systems is a requirement of this specification.

- B. Related Work Specified Elsewhere

1. Conduit, line voltage wiring, outlets, and disconnect switches specified in Division 16.
2. Magnetic starters and thermal protective devices (heaters) not a factory mounted integral part of packaged equipment are specified in Division 16.

1.3 SITE OBSERVATION

- A. The Contractor shall examine the site and understand the conditions which may affect the performance of work of this Division before submitting proposals for this work.

- B. No subsequent allowance for time or money will be considered for any consequence related to failure to examine existing site conditions.

1.4 DRAWINGS

- A. Mechanical drawings show general arrangement of piping, ductwork, equipment, etc; however, locations are to be regarded as shown diagrammatically only. Follow as closely as actual building construction and work of other trades will permit.
- B. Because of the small scale of mechanical drawings, it is not possible to indicate all offsets, fittings, and accessories which may be required. Investigate existing structural and finished conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.
- C. If changes in location of piping, equipment, ducts, etc. are required due to lack of coordination of work under this division, such changes shall be made without charge. Contractor shall review drawings with local and state agencies having jurisdiction and any changes required by them shall be brought to the attention of the Architect prior to bidding or commencement of work.

1.5 CODE REQUIREMENTS, FEES, AND PERMITS

- A. The work shall be installed in accordance with the following applicable codes, ordinances and standards unless otherwise specified. The codes and standards shall include but not be limited to and be of the latest and current editions.
 - 1. American Boiler and Affiliated Industries (AB and AI)
 - 2. American Gas Association (AGA)
 - 3. Air Movement and Control Association (AMCA)
 - 4. American National Standards Institute (ANSI)
 - 5. Air Conditioning & Refrigeration Institute (ARI)
 - 6. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) - ASHRAE 90.1-2004
 - 7. American Society of Mechanical Engineers (ASME)
 - 8. American Society of Testing Materials (ASTM)
 - 9. American Standards Association (ASA)
 - 10. American Water Works Association (AWWA)
 - 11. American Welding Society (AWS)
 - 12. Associated Air Balance Council (AABC)
 - 13. Heat Exchange Institute (HEI)
 - 14. Hydraulic Institute (HI)
 - 15. BR
 - 16. National Electrical Code (NEC)
 - 17. National Fire Protection Association (NFPA)
 - 18. Sheet Metal and Air Conditioning contractors National Association (SMACNA)
 - 19. Underwriters Laboratories (UL)

20. International Building Code (IBC) 2006 Ed
 21. International Mechanical Code (IMC) 2006 Ed
 22. International Plumbing Code (IPC) with Utah Amendments 2006 Ed\
 23. International Energy Conservation Code (IECC) 2006 Ed
 24. Utah State Safety Orders (OSHA/UOSH)
 25. Utah Fire Rating Bureau
 26. Utah Boiler and Pressure Vessel Law
 27. Utah Air Conservation Regulations/Waste Disposal regulations.
 28. ASHRAE Ventilation STD.62-2004
- B. Should drawings conflict with any code, the code shall govern. If drawings and specifications establish a quality exceeding the code, the drawings and specifications shall govern. If conflicts do exist among the drawings, specifications and codes, the same shall be brought to the attention of the Architect in writing prior to bidding, otherwise Contractor shall comply with applicable codes.
- C. The latest edition of all codes shall be used.
- D. Contractor shall give all notices, obtain all necessary permits, file necessary plans, prepare documents and obtain approvals, and pay all fees required for completion of the mechanical and plumbing work outlined in this Division of the specifications and shown on the Mechanical Drawings.

1.6 OPERATION AND MAINTENANCE MANUAL FOR MECHANICAL SYSTEMS

- A. Upon completion of work and before final payment, Contractor shall furnish and deliver to the Owner, through the Architect, installation, operation and maintenance manuals with instructions for all new materials and equipment used in the building. The contractor shall provide three (3) hard copies of the manuals, and three (3) CD's with electronic copies of the manuals. Electronic information shall be .PDF format. The CD's shall include the same information as the hard copies, and shall be organized in the same manner with electronic bookmarks for each section. CD case and the CD itself shall be labeled the same as the hard copies of the manuals.
- B. Bind Operation and Maintenance Manual for Mechanical Systems in a hard-backed piano hinge loose-leaf binder with strong sturdy cover. The project name shall be on the spine and the front of the binder. The front of the binder shall include the following information:

OPERATION
AND
MAINTENANCE
MANUAL
for MECHANICAL SYSTEMS of
(Name of Project)
(Location of Project)
(Date of Project Award)
(Name of Architect)

C. Introduction

1. Title page including name of project, project number, date awarded and date of substantial completion.
2. Second page shall contain the names, phone numbers and addresses of Architect, Consulting Engineers, Mechanical Contractor, and General Contractor.
3. Third page shall include a Table of Contents for the entire manual.

D. First Section - Summary information including:

1. First page shall contain the contractor's warranties.
2. Second page shall contain a list of names, addresses and phone numbers of contractors and all sub-contractors and work to which each was assigned.
3. Final page or pages shall contain an equipment list. The list shall contain each item of equipment or material for which a submittal was required giving ID or tag no as contained on the drawings make and model No. Serial No. Identification No. Location in building, function along with the name, address, and phone number of the supplier.

E. Second Section - Mechanical Equipment O&M data including:

1. Mechanical maintenance schedule, including a lubrication list when necessary.
2. Mechanical Equipment Operation and Maintenance Data including:
 - a. Equipment descriptions
 - b. Detailed installation instruction, operating and maintenance instructions. Instructions include in a step by step manner identifying start-up, operating, shutdown and emergency action sequence sufficiently clear so a person unfamiliar with the equipment could perform its operations.
 - c. Equipment drawings, performance curves, operating characteristics, etc.
 - d. Name addresses and phone number of manufacturer, fabricator and local vender clearly printed or stamped on cover.
 - e. Complete parts listing which include catalog number, serial number, contract number or other accurate provision for ordering replacement and spare parts.
 - f. Certified drawings, where applicable, showing assembly of parts and general dimensions.
3. Approved Mechanical submittals

F. Third Section - Plumbing Equipment O&M data including:

1. Section shall contain general product catalog cuts, as well as exploded view drawings with parts lists for all valves and other items with multiple parts.

2. Approved Plumbing submittals

G. Fourth Section - Controls O&M data including:

1. Sequence of Operation
2. Description of each operating system included location of switches, breakers, thermostats, and control devices. Provide a single line diagram, showing set points, normal operating parameters for all loads, pressures, temperatures and flow check points; Describe all alarms and cautions for operation.
3. Provide schematic control diagrams, panel diagrams, wiring diagrams, etc. for each separate fan system, chilled water system, hot water system, exhaust air system, pumps, etc. Each control diagram shall show a schematic representation of mechanical equipment and location of start-stop switches, insertion thermostats, thermometers, pressure gauges, automatic valves, etc. The correct reading for each control instrument shall be marked on the diagram.

H. The Fifth Section shall contain a complete air and water test and balance report. The report shall contain the name, address and phone number of the agency. It shall also include:

1. Floor plans showing all air openings and thermometer locations clearly marked and cross referenced with data sheets. Format may be 8 1/2 x 11 or 11x14 if legible.
2. Data sheets showing amount of air and water at each setting. See sections 15950.
3. List of equipment with date of last calibration.

I. Drawings and reproducible masters of drawings as required in individual specification sections, are not to be bound in volumes but are to be delivered separate with the maintenance manuals.

J. See the following checklist for assistance in assembling manual:

Item #	Description	Y, N, or NA
1.	3 ring heavy duty binder with Project name, number and date on cover and project name on spine.	
2.	O&M manual on CD (with label on CD matching label on manual). Electronic copy shall be a PDF file with bookmarks that match the tabs in the hard copy.	
3.	Title Page [including project name, number, address, date awarded, date of substantial completion]	
4.	Second Page Contact List [including architect (if applicable), mechanical engineer, mechanical contractor, and general contractor (if applicable)]	
5.	Table of Contents	
6.	Section 1 - Summary	
A.	Warranty	
B.	Mechanical's Sub-contractor List	

C.	Vendor List	
D.	Equipment List	
7.	Section 2 – Mechanical Equipment	
A.	Maintenance Schedule (including lubrication list)	
B.	Mechanical Equipment O&M Data (for each piece of equipment submitted) per specifications	
C.	Approved mechanical submittals	
8.	Section 3 – Plumbing Equipment	
A.	Plumbing equipment O&M data	
B.	Approved plumbing submittals	
9.	Section 4 - Controls	
A.	Sequence of Operation	
B.	Controls diagrams	
C.	Controls Equipment	
10.	Section 5 – Test and Balance Report	
A.	Complete Test and Balance Report per specifications	

1.7 OPERATION AND MAINTENANCE INSTRUCTIONS

- A. Contractor shall instruct building maintenance personnel in the operation and maintenance of the installed mechanical systems utilizing the Operation and Maintenance Manual when so doing.
- B. Minimum instruction periods shall be as follows -
 - 1. Mechanical - Two hours.
- C. Instruction periods shall occur before final site observation when systems are properly working and before final payment is made.
- D. None of these instructional periods shall overlap each other.
- E. An additional four hours of instruction will be provided by each contractor, after 60 days of system operation by owner to insure proper system operation and answer questions.

1.8 RECORD DRAWINGS

- A. Contractor shall keep an up-to-date set of mechanical and plumbing drawings in his custody showing all changes in red, clearly defined and neatly drafted by him. At the end of construction, he shall turn these drawings over to the Architect. Record drawings must be completed and submitted prior to final site observation

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION 15010

SECTION 15050 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Sleeves.
 - 5. Escutcheons.
 - 6. Mechanical demolition.
 - 7. Equipment installation requirements common to equipment sections.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Dielectric fittings.
 - 2. Mechanical sleeve seals.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- B. All materials, piping, etc. shall be new, and domestically made of the best commercial quality obtainable, consistent with specified materials and for the purpose or function intended unless specifically approved in writing prior to bid.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 15 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.

2.3 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - e. Linkseal.
 - f. Prior Approved Equal.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.4 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- E. PVC Pipe: ASTM D 1785, Schedule 40.

2.5 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

2.6 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 MECHANICAL DEMOLITION

- A. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.
 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Drawings do not show every offset, or bend that may be required. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors where indicated on drawings and where penetrating will be visible to public.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

END OF SECTION 15050

SECTION 15075 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:
 - 1. Equipment nameplates.
 - 2. Equipment signs.
 - 3. Access panel and door markers.
 - 4. Pipe markers.
 - 5. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.5 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with location of access panels and doors.

- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 - 1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 - 2. Location: Accessible and visible.
 - 3. Fasteners: As required to mount on equipment.
- B. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
 - 1. Data: Instructions for operation of equipment and for safety procedures.
 - 2. Engraving: Manufacturer's standard letter style, 1/4" or larger with terms to match equipment identification.
 - 3. Thickness: 1/8 inch, unless otherwise indicated.
 - 4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
- C. Access Panel and Door Markers: 1/16" thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8" center hole for attachment.
 - 1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.2 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
 - 1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 - 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
 - 3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.

4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
 5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
1. Fuel-burning units, including boilers, furnaces, heaters, etc.
 2. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 4. Fans, blowers, primary balancing dampers, and mixing boxes.
 5. Packaged HVAC central-station and zone-type units.
- B. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
1. Identify mechanical equipment with black equipment markers with white lettering.
 2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 4. Include signs for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fuel-burning units, including boilers, furnaces, heaters, etc.
 - c. Pumps, compressors, chillers, condensers, and similar motor-driven units.

- d. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - e. Fans, blowers, primary balancing dampers, and mixing boxes.
 - f. Packaged HVAC central-station and zone-type units.
 - g. Tanks and pressure vessels.
 - h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- C. Install access panel markers with screws on equipment access panels.

3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:
- 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

3.4 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.5 CLEANING

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 15075

SECTION 15080 - HVAC AND PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Insulation Materials:
 - a. Flexible elastomeric.
 - b. Mineral fiber.
 - 2. Insulating cements.
 - 3. Adhesives.
 - 4. Lagging adhesives.
 - 5. Field-applied jackets.
 - 6. Tapes.
 - 7. Securements.
 - 8. Corner angles.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Qualification Data: For qualified Installer.
- C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- D. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 15 Section "Hangers and Supports."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
 - d. Armaflex
 - e. Prior approved equal.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; All-Service Duct Wrap.
 - f. Prior approved equal.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Insulco, Division of MFS, Inc.; Triple I.
 - b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.
 - c. Prior approved equal.

2.3 ADHESIVES

- A. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aero seal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - d. RBX Corporation; Rubatex Contact Adhesive.
 - e. Prior approved equal.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 - f. Prior approved equal.

2.4 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-52.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
 - c. Marathon Industries, Inc.; 130.
 - d. Mon-Eco Industries, Inc.; 11-30.
 - e. Vimasco Corporation; 136.
 - f. Prior approved equal.
2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
3. Service Temperature Range: Minus 50 to plus 180 deg F.
4. Color: White.

2.5 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
 - d. Prior approved equal.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

2.6 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.
- C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
1. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 2. Pipe: Install insulation continuously through floor penetrations.
 3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
 1. Install preformed valve covers manufactured of same material as pipe insulation when available.

2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 MINERAL-FIBER INSULATION INSTALLATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and

over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.8 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

- B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return, Air.
4. Indoor, exposed return, Air.
5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
6. Indoor, concealed exhaust.

7. Indoor, exposed exhaust.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

B. Concealed, low pressure, round rectangular, and flat-oval exhaust-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

C. Rectangular, low pressure, supply-air duct insulation shall be lined per Section "Metal Ducts".

D. Rectangular, return-air duct insulation shall be lined per Section "Metal Ducts".

E. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

F. Exposed or medium pressure, round and flat-oval, supply-air, and return air duct insulation shall be a perforated linear. See Section "Metal Ducts".

3.11 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
4. Vertical roof drain piping.

C. Piping System insulation:

1. Hydronic Piping - Mineral Fiber, per chart.
2. Domestic Cold Water Piping -Mineral Fiber, 1/2"
3. Domestic Hot Water Piping -Mineral Fiber, per chart
4. Horizontal Roof Drain Piping - Mineral Fiber, 1/2".
5. Refrigerant Piping - Flexible elastomeric, 1".

3.12 INDOOR PIPING INSULATION SCHEDULE

- A. Minimum Pipe Insulation Thickness from ANSI/ASHRAE/IESNA Standard 90.1-2004, with modifications per 2006 IECC

Fluid Design Operating Temp. Range (°F)	Insulation Conductivity		Nominal				
	Conductivity Btu•in./(h•ft ² •°F)	Mean Rating Temp. °F	<1	1 to <1-1/2	1-1/2 to <4	4 to <8	≥8
Heating Systems (Steam, Steam Condensate, and Hot Water)							
>350	0.32-0.34	250	2.5	3.0	3.0	4.0	4.0
251-350	0.29-0.32	200	1.5	3.0	3.0	3.0	3.0
201-250	0.27-0.30	150	1.5	1.5	2.0	2.0	2.0
141-200	0.25-0.29	125	1.0	1.0	2.0	2.0	2.0
105-140	0.22-0.28	100	0.5	0.5	1.0	1.0	1.0
Domestic and Service Hot Water Systems							
105+	0.22-0.28	100	0.5	0.5	1.0	1.0	1.0
Cooling Systems (Chilled Water, Brine, and Refrigerant)							
40-60	0.22-0.28	100	0.5	1.0	1.5	1.5	1.5
<40	0.22-0.28	100	0.5	1.0	1.5	1.5	1.5

END OF SECTION 15083

SECTION 15140 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
 - 2. Flexible connectors.
 - 3. Escutcheons.
 - 4. Sleeves and sleeve seals.
 - 5. Wall penetration systems.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to 2006 IBC.

1.4 SUBMITTALS

- A. Product Data: For the following products:
 - 1. Specialty valves.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Flexible connectors.
 - 5. Water meters.
 - 6. Backflow preventers and vacuum breakers.
 - 7. Escutcheons.
 - 8. Sleeves and sleeve seals.
 - 9. Water penetration systems.
- B. Water Samples: Specified in "Cleaning" Article.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 for potable domestic water piping and components.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not proceed with interruption of water service without Owner's written permission.

1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
 - 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - 4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.3 PIPING JOINING MATERIALS

- A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.
- C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One Piece, Stamped Steel: Chrome-plated finish with setscrew or spring clips.
- E. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.
- F. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge, setscrew or spring clips.
- G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.5 SLEEVES

- A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- D. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
- E. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- F. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
- G. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.6 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Advance Products & Systems, Inc.
 2. Calpico, Inc.
 3. Metraflex, Inc.
 4. Pipeline Seal and Insulator, Inc.
 5. Prior approved equal.
- B. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Carbon steel.
 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.7 WALL PENETRATION SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. SIGMA.
 2. Prior approved equal.
- B. Description: Wall-sleeve assembly, consisting of housing and gland, gaskets, and pipe sleeve.
 1. Carrier-Pipe Deflection: Up to 5 percent without leakage.
 2. Housing: Ductile-iron casting with hub, waterstop, anchor ring, and locking devices. Include gland, bolts, and nuts.
 3. Housing-to-Sleeve Gasket: EPDM rubber.
 4. Housing-to-Carrier-Pipe Gasket: AWWA C111, EPDM rubber.
 5. Pipe Sleeve: AWWA C151, ductile-iron pipe.

2.8 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.

- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105.
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 15 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 15 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 15 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- H. Install domestic water piping level without pitch and plumb.
- I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- J. Install seismic restraints on piping. Comply with requirements in Division 15 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- L. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

- M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- N. Install piping adjacent to equipment and specialties to allow service and maintenance.
- O. Install piping to permit valve servicing.
- P. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- Q. Install piping free of sags and bends.
- R. Install fittings for changes in direction and branch connections.
- S. Install PEX piping with loop at each change of direction of more than 90 degrees.
- T. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- U. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 15 Section "Meters and Gages for Plumbing Piping" for pressure gages.
- V. Install thermostats in hot-water circulation piping. Comply with requirements in Division 15 Section "Domestic Water Pumps" for thermostats.
- W. Install thermometers on outlet piping from each water heater. Comply with requirements in Division 15 Section "Meters and Gages for Plumbing Piping" for thermometers.

3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 15 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 15 Section "Domestic Water Piping Specialties."
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 15 Section "Domestic Water Piping Specialties" for balancing valves.

3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. NPS 2 and Larger: Sleeve-type coupling.

3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.6 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.
- C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 15 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- B. Comply with requirements in Division 15 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 6. NPS 6: 10 feet with 5/8-inch rod.
 - 7. NPS 8: 10 feet with 3/4-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.

- G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 15 plumbing fixture Sections for connection sizes.
 - 4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 4. Bare Piping in Unfinished Service Spaces: One piece, stamped steel with set screw or spring clips.
 - 5. Bare Piping in Equipment Rooms: One piece, stamped steel with set screw or spring clips.
 - 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.
- C. Escutcheons for Existing Piping:
 - 1. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
 - 2. Insulated Piping: Split plate, stamped steel with concealed or exposed-rivet hinge and spring clips.
 - 3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.

4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
5. Bare Piping in Unfinished Service Spaces: Split plate, stamped steel with exposed-rivet hinge and set screw or spring clips.
6. Bare Piping in Equipment Rooms: Split plate, stamped steel with set screw or spring clips.
7. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

3.10 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint.
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint.
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
 1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
 3. Sleeves for Piping Passing through Gypsum-Board Partitions:

- a. PVC pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
 - c. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
- 4. Sleeves for Piping Passing through Concrete Roof Slabs: Steel pipe Insert type.
- 5. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.
 - c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 - d. Do not use sleeves when wall penetration systems are used.
- 6. Sleeves for Piping Passing through Interior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems" for firestop materials and installations.

3.11 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.12 WALL PENETRATION SYSTEM INSTALLATION

- A. Install wall penetration systems in new, exterior concrete walls.
- B. Assemble wall penetration system components with sleeve pipe. Install so that end of sleeve pipe and face of housing are flush with wall. Adjust locking devices to secure sleeve pipe in housing.

3.13 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 15 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

- B. Label pressure piping with system operating pressure.

3.14 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

- B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

- C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 100 psig, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

- D. Domestic water piping will be considered defective if it does not pass tests and inspections.

- E. Prepare test and inspection reports.

3.15 ADJUSTING

- A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
 2. Open shutoff valves to fully open position.
 3. Open throttling valves to proper setting.
 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.16 CLEANING

- A. Clean and disinfect potable and non-potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Clean non-potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.17 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and soldered joints.

3.18 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
 2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 15140

SECTION 15151 - CONDENSATE DRAIN PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following for soil, waste, and vent piping inside the building:
 - 1. Pipe, tube, and fittings.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. LLDPE: Linear, low-density polyethylene plastic.
- D. NBR: Acrylonitrile-butadiene rubber.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water Insert pressure.
 - 2. Sanitary Sewer, Force-Main Piping: 100 psig.

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
- C. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - 1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - a. Manufacturers:
 - 1) ANACO.
 - 2) Fernco, Inc.
 - 3) Ideal Div.; Stant Corp.
 - 4) Mission Rubber Co.

- 5) Tyler Pipe; Soil Pipe Div.
 - 6) Prior approved equal.
2. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
 - a. Manufacturers:
 - 1) ANACO.
 - 2) Clamp-All Corp.
 - 3) Ideal Div.; Stant Corp.
 - 4) Mission Rubber Co.
 - 5) Tyler Pipe; Soil Pipe Div.
 - 6) Prior approved equal.
3. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.
 - a. Manufacturers:
 - 1) MG Piping Products Co.
 - 2) Prior approved equal.

2.4 PVC PIPE AND FITTINGS

- A. Solid-wall PVC pipe: ASTM D 2665, drain, waste, and vent.
 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vents patterns.
- B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
 1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. PVC Socket Fittings: ASTM D 2666, made to ASTM D 3311, drain, waste, and vent patterns and to fit Series PS 100 sewer and drain pipe.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, condensate piping NPS 4 and smaller shall be any of the following:

1. Hubless cast-iron soil pipe and fittings and solvent stack fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
2. Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.

3.2 PIPING INSTALLATION

- A. Plastic piping is not allowed in ceiling return plenums. Where piping is exposed to ceiling plenums, cast iron shall only be allowed.
- B. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."
- C. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- D. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- E. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- F. Install underground ABS and PVC soil and waste drainage piping according to ASTM D 2321.
- G. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."
- B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

- D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Seismic-restraint devices are specified in Division 15 Section "Mechanical Vibration Controls and Seismic Restraints."
- B. Pipe hangers and supports are specified in Division 15 Section "Hangers and Supports." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Install individual, straight, horizontal piping runs according to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install supports according to Division 15 Section "Hangers and Supports."
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. NPS 6: 60 inches with 3/4-inch rod.
 - 5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
 - 1.

3.6 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 15150

SECTION 15734 - COMPUTER-ROOM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Floor-mounted computer-room air conditioners, 6 tons and larger.

1.3 DEFINITION

- A. BAS: Building automation system.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For computer-room air conditioners. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Coordination Drawings: Plans, elevations, and other details, drawn to scale, using input from Installers of the items involved.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For computer-room air conditioners to include in operation, and maintenance manuals.
- F. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1
- D. ASME Compliance: Fabricate and label water-cooled condenser shell to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

1.6 COORDINATION

- A. Coordinate layout and installation of computer-room air conditioners and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.
- B. Coordinate installation of computer-room air conditioners with computer-room access flooring Installer.
- C. Coordinate sizes and locations of concrete bases with actual equipment provided.
- D. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of computer-room air conditioners that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
 - 2. Warranty Period for Humidifiers: Manufacturer's standard, but not less than three years from date of Substantial Completion.
 - 3. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fan Belts: One set(s) for each belt-driven fan.
 - 2. Filters: One set(s) of filters for each unit.

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED UNITS 6 TONS AND LARGER

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Liebert Corporation.
 - 2. Data Aire Inc
 - 3. Compu-Aire, Inc.
 - 4. Prior approved equal.
- B. Description: Packaged, factory assembled, prewired, and prepiped; consisting of cabinet, fans, filters, humidifier, and controls.
- C. Cabinet and Frame: Welded steel, braced for rigidity, and supporting compressors and other mechanical equipment and fittings.
 - 1. Doors and Access Panels: Galvanized steel with polyurethane gaskets, hinges, and concealed fastening devices.
 - 2. Insulation: Thermally and acoustically insulate cabinet interior with 1-inch- thick duct liner.
 - 3. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
 - 4. Finish of Exterior Surfaces: Baked-on, textured vinyl enamel; color as selected from manufacturer's standard colors.
 - 5. Floor Stand: Welded tubular steel, high, with adjustable legs and vibration isolation pads for above floor return grille.
- D. Supply-Air Fan(s):
 - 1. Double-inlet, forward-curved centrifugal fan(s); statically and dynamically balanced.
 - 2. Drive: V-belt, with steel shaft with self-aligning ball bearings and cast-iron or steel sheaves, variable- and adjustable-pitch motor sheave, minimum of two matched belts, with drive rated at a minimum of two times the nameplate rating of motor.
 - 3. Provide with top discharge supply plenum.
- E. Refrigeration System:

1. Compressors: Digital scroll; with cylinder unloaders, oil strainer, internal motor overload protection, resilient suspension system, crankcase heater, manual-reset high-pressure switch, and pump-down low-pressure switch.
 2. Refrigeration Circuits: Two; each with hot-gas mufflers, thermal-expansion valve with external equalizer, liquid-line solenoid valve, liquid-line filter-dryer, sight glass with moisture indicator, service shutoff valves, charging valves, and charge of refrigerant.
 3. Refrigerant: R-407C or R-410A.
 4. Refrigerant Evaporator Coil: Alternate-row or split-face-circuit, direct-expansion coil of seamless copper tubes expanded into aluminum fins.
 - a. Mount coil assembly over stainless-steel drain pan complying with ASHRAE 62.1 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.
 5. Remote Air-Cooled Refrigerant Condenser: Corrosion-resistant cabinet, copper-tube aluminum-fin coils arranged for two circuits, multiple direct-drive propeller fans with permanently lubricated ball bearings, and single-phase motors with internal overload protection and integral electric control panel and disconnect switch. Control capacity by cycling fans.
- F. Extended-Surface, Disposable, Panel Filter: Pleated, lofted, nonwoven, reinforced cotton fabric; supported and bonded to welded-wire grid; enclosed in cardboard frame with 2-inch- thick, disposable, glass-fiber prefilter.
1. Thickness: 2 inches.
 2. Merv (ASHRAE 52.2): 11.
- G. Electrode Steam Humidifier: Self-contained, microprocessor-controlled unit with disposable, polypropylene-plastic cylinders, and having field-adjustable steel electrodes and stainless-steel steam dispersion tube.
1. Plumbing Components and Valve Bodies: Plastic, linked by flexible rubber hosing, with water fill with air gap and solenoid valve incorporating built-in strainer, pressure-reducing and flow-regulating orifice, and drain with integral air gap.
 2. Control: Fully modulating to provide gradual 0 to 100 percent capacity with field-adjustable maximum capacity; with high-water probe.
 3. Drain Cycle: Field-adjustable drain duration and drain interval.
- H. Integral Electrical Controls: Unit-mounted electrical enclosure with piano-hinged door, grounding lug, combination magnetic starters with overload relays, circuit breakers and cover interlock, and fusible control-circuit transformer.
- I. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.
- J. Microprocessor-Control System: Continuously monitors operation of process cooling system; continuously displays room temperature and room relative humidity; sounds alarm on system malfunction and simultaneously displays problem. If more than one

malfunction occurs, system displays fault in sequence with room temperature and continues to display fault when malfunction is cleared until system is reset.

1. Malfunctions:

- a. Power loss.
- b. Loss of airflow.
- c. Clogged air filter.
- d. High room temperature.
- e. Low room temperature.
- f. High humidity.
- g. Low humidity.
- h. Smoke/fire.
- i. Water under floor.
- j. Supply fan overload.
- k. Compressor No. 1 - Overload.
- l. Compressor No. 1 - Low Pressure.
- m. Compressor No. 1 - High Pressure.
- n. Compressor No. 2 - Overload.
- o. Compressor No. 2 - Low Pressure.
- p. Compressor No. 2 - High Pressure.

2. Digital Display:

- a. Control power on.
- b. Humidifying.
- c. Dehumidifying.
- d. Compressor No. 1 - Operating.
- e. Compressor No. 2 - Operating.
- f. Heat operating.
- g. Economy cooling.

3. Push buttons shall stop and start process cooling system, silence audible alarm, test indicators, and display room's relative humidity.

4. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display unit status and alarms.

a. Hardwired Points:

- 1) Monitoring: On-off status, common trouble alarm space temperature space relative humidity.
- 2) Control: On-off operation, space temperature set-point adjustment space relative humidity set-point adjustment.

- b. Industry-accepted, open-protocol Network Interface Card (NIC) shall provide building BAS is a CSI/TAC system by Utah Controls at 801-990-1950 communication interface with the BAS shall enable the BAS operator to remotely control and monitor the unit from an operator workstation. Control features and monitoring points displayed locally at unit control panel shall be available through the BAS.

2.2 FAN MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 15 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 16 Sections.

2.3 CAPACITIES AND CHARACTERISTICS: See Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for hydronic piping systems to verify actual locations of piping connections before equipment installation.
- C. Examine walls, floors, and roofs for suitable conditions where computer-room air conditioners will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install computer-room air conditioners level and plumb, maintaining manufacturer's recommended clearances.
- B. Computer-Room Air-Conditioner Mounting: Install using elastomeric pads. Comply with requirements for vibration isolation devices specified in Division 15 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - 1. Minimum Deflection: 1/4 inch.
- C. Air-Cooled Refrigerant Condenser Mounting: Install using elastomeric pads. Comply with requirements for vibration isolation devices specified in Division 15 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - 1. Minimum Deflection: 1/4 inch.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Water and Drainage Connections: Comply with applicable requirements in Division 15 Section "Domestic Water Piping." Provide adequate connections for water-cooled units, condensate drain, and humidifier flushing system.
- D. Hot-Water Heating Piping: Comply with applicable requirements in Division 15 Section "Hydronic Piping." Provide shutoff valves in inlet and outlet piping to heating coils.
- E. Steam and Condensate Piping: Comply with applicable requirements in Division 15 Section "Steam and Condensate Piping." Provide shutoff valves in steam inlet and steam trap in condensate outlet piping to heating coils.
- F. Condenser-Water Piping: Comply with applicable requirements in Division 15 Section "Hydronic Piping." Provide shutoff valves in water inlet and outlet piping on water-cooled units.
- G. Refrigerant Piping: Comply with applicable requirements in Division 15 Section "Refrigerant Piping." Provide shutoff valves and piping.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Computer-room air conditioners will be considered defective if they do not pass tests and inspections.

- E. Prepare test and inspection reports.
- F. After startup service and performance test, change filters and flush humidifier.

3.5 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain computer-room air conditioners.

END OF SECTION 15734

SECTION 15815 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Single-wall rectangular ducts and fittings.
 - 2. Single-wall round and flat-oval ducts and fittings.
 - 3. Sheet metal materials.
 - 4. Sealants and gaskets.
 - 5. Hangers and supports.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated.
 - 1. Static-Pressure Classes:
 - a. Supply Ducts (except in Mechanical Rooms): 2-inch wg.
 - b. Supply Ducts (Upstream from Air Terminal Units): 3-inch wg.
 - c. Supply Ducts (Downstream from Air Terminal Units): 1-inch wg.
 - d. Supply Ducts (in Mechanical Equipment Rooms): 2-inch wg.
 - e. Return Ducts (Negative Pressure): 1-inch wg.
 - f. Exhaust Ducts (Negative Pressure): 1-inch wg.
 - 2. Leakage Class:
 - a. Round Supply-Air Duct: 3 cfm/100 sq. ft. at 1-inch wg.
 - b. Flat-Oval Supply-Air Duct: 3 cfm/100 sq. ft. at 1-inch wg.
 - c. Rectangular Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg.
 - d. Flexible Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg.
- B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

1.4 SUBMITTALS

- A. Product Data: For each type of the following products:
 1. Liners and adhesives.
 2. Sealants and gaskets.
 3. Seismic-restraint devices.
- B. Welding certificates.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction

Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
 - f. Metco.
 - g. Prior approved equal.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter (diameter of the round sides connecting the flat portions of the duct).
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing

requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Solids Content: Minimum 65 percent.
 - 3. Shore A Hardness: Minimum 20.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. VOC: Maximum 75 g/L (less water).
 - 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - 8. Service: Indoor or outdoor.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- C. Flanged Joint Sealant: Comply with ASTM C 920.
 - 1. General: Single-component, acid-curing, silicone, elastomeric.
 - 2. Type: S.

3. Grade: NS.
4. Class: 25.
5. Use: O.

D. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to

size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round and flat-oval ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 15 Section "Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 SEAM AND JOINT SEALING

- A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.
 - 1. For static-pressure classes 1- and 1/2-inch wg, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Seal Class C, except as follows:
 - a. Ducts that are located directly in zones they serve.

3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 15 Section "Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual."
 - 2. Test the following systems:

- a. Supply air.
 - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 4. Test for leaks before insulation application.
 - 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
- 1. Visually inspect duct system to ensure that no visible contaminants are present.
 - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
- a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
- 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 15 Section "Duct Accessories" for access panels and doors.
 - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
- 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
- 1. Air outlets and inlets (registers, grilles, and diffusers).

2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.7 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel:

B. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.
2. Stainless-Steel Ducts: Galvanized steel.
3. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.

C. Double-Wall Duct Interstitial Insulation:

1. Supply- and Return-Air Ducts: 1 inch thick.

D. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

E. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."

- a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
- 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

F. Duct Schedule

- 1. Rectangular duct with liner:
 - a. Low pressure supply and return.
- 2. Rectangular duct wrapped with insulation:
 - a. Low pressure exhaust and fresh air.
- 3. Single wall round with wrapped insulation.
 - a. Low pressure supply and return.

END OF SECTION 15815

SECTION 15855 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.
- B. Related Sections include the following:
 - 1. Division 15 Section "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 SUBMITTALS

- A. Product Data: For each product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 GRILLES AND REGISTERS

- A. Fixed Face Ceiling Return, Exhaust, or Transfer Air Grille:
 - 1. Products:

- a. Carnes; RSLA.
 - b. Krueger; S85H.
 - c. Price Industries; 535.
 - d. Titus; 355RL.
 - e. Tuttle & Bailey; T70D.
 - f. Or equal by:
 - 1) A-J Manufacturing Co., Inc.
 - 2) Anemostat; a Mestek Company.
 - 3) Dayus Register & Grille.
 - 4) Hart & Cooley, Inc.; Hart & Cooley Div.
 - 5) Nailor Industries of Texas Inc.
- 2. Material: Steel.
 - 3. Finish: Baked enamel, white.
 - 4. Face Arrangement: 1/2 inch horizontal blade spacing.
 - 5. Frame: 1-1/4 inches wide.

2.3 CEILING DIFFUSER OUTLETS

A. Round Ceiling Diffuser Duct Mounted Exposed:

- 1. Manufacturers:
 - a. Price RCD or equal by:
 - 1) Anemostat; a Mestek Company.
 - 2) Carnes.
 - 3) Hart & Cooley, Inc.; Hart & Cooley Div.
 - 4) METALAIRE, Inc.; Metal Industries Inc.
 - 5) Nailor Industries of Texas Inc.
 - 6) Titus.
 - 7) Tuttle & Bailey.
 - 8) Prior approved equal.
- 2. Material: Heavy gauge spun steel.
- 3. Finish: Baked enamel, color selected by Architect.
- 4. Face Style: Three cone.
- 5. Pattern: Two position horizontal.

B. Rectangular and Square Ceiling Diffusers:

- 1. Products:
 - a. Carnes; SK-A.
 - b. Krueger; SH.
 - c. METALAIRE, Inc., Metal Industries Inc.; 55005.
 - d. Price Industries; SMD.
 - e. Titus; TDC.
 - f. Tuttle & Bailey; MS.

g. Or equal by:

- 1) A-J Manufacturing Co., Inc.
- 2) Anemostat; a Mestek Company.
- 3) Hart & Cooley, Inc.; Hart & Cooley Div.
- 4) Nailor Industries of Texas Inc.

2. Material: Steel.
3. Finish: Baked enamel, white.

2.4 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, provide lay-in ceiling module. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 15855

SECTION 15900 - HVAC INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 15734 - Computer Room Air Conditioning Units.

1.2 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
- B. Tie new computer room cooling unit into existing CSI/TAC system by Utah Controls.
- C. Modify VAV sequence in data room to function as emergency back-up only.

1.3 DEFINITIONS

- A. DDC: Direct digital control.
- B. I/O: Input/output.
- C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.
- D. MS/TP: Master slave/token passing.
- E. PC: Personal computer.
- F. PID: Proportional plus integral plus derivative.
- G. RTD: Resistance temperature detector.

1.4 SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
 2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
 3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- C. Qualification Data: For Installer and manufacturer.
- D. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with ASHRAE 135 for DDC system components.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.
- B. System Software: Update to latest version of software at Project completion.

1.7 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

- C. Coordinate equipment with Division 16 Section "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Replacement Materials: One replacement diaphragm or relay mechanism for each unique controller.
 - 2. Maintenance Materials: One thermostat adjusting key(s).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CONTROL SYSTEM

- A. Manufacturers:
 - 1. CSI/TAC by Utah Controls.
- B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.
- C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

2.3 CONTROL CABLE

- A. Electronic and fiber-optic cables for control wiring are specified in Division 16 Section "Voice and Data Communication Cabling."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that conditioned power supply is available to control units and operator workstation.

3.2 INSTALLATION

- A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- B. Connect and configure equipment and software to achieve sequence of operation specified.
- C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation.
- D. Install labels and nameplates to identify control components according to Division 15 Section "Mechanical Identification."

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Division 16 Section "Raceways and Boxes."
- B. Install building wire and cable according to Division 16 Section "Conductors and Cables."
- C. Install signal and communication cable according to Division 16 Section "Voice and Data Communication Cabling."
 - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
 - 2. Install exposed cable in raceway.
 - 3. Install concealed cable in raceway.
 - 4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
 - 5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 - 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
 - 7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 - 2. Test and adjust controls and safeties.
 - 3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 4. Pressure test control air piping at 30 psig or 1.5 times the operating pressure for 24 hours, with maximum 5-psig loss.
 - 5. Pressure test high-pressure control air piping at 150 psig and low-pressure control air piping at 30 psig for 2 hours, with maximum 1-psig loss.
 - 6. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 - 7. Test each point through its full operating range to verify that safety and operating control set points are as required.
 - 8. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 - 9. Test each system for compliance with sequence of operation.
 - 10. Test software and hardware interlocks.
- C. DDC Verification:
 - 1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
 - 2. Check instruments for proper location and accessibility.
 - 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
 - 4. Check instrument tubing for proper fittings, slope, material, and support.
 - 5. Check installation of air supply for each instrument.
 - 6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
 - 7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
 - 8. Check temperature instruments and material and length of sensing elements.
 - 9. Check control valves. Verify that they are in correct direction.
 - 10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
 - 11. Check DDC system as follows:

- a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.
- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

- A. Calibrating and Adjusting:
 - 1. Calibrate instruments.
 - 2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
 - 3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
 - 4. Control System Inputs and Outputs:
 - a. Check analog inputs at 0, 50, and 100 percent of span.
 - b. Check analog outputs using milliamper meter at 0, 50, and 100 percent output.
 - c. Check digital inputs using jumper wire.
 - d. Check digital outputs using ohmmeter to test for contact making or breaking.
 - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
 - 5. Flow:
 - a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
 - b. Manually operate flow switches to verify that they make or break contact.
 - 6. Pressure:
 - a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
 - b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
 - 7. Temperature:
 - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
 - b. Calibrate temperature switches to make or break contacts.

8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
 9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
 10. Provide diagnostic and test instruments for calibration and adjustment of system.
 11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.
- B. Adjust initial temperature and humidity set points.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 1 Section "Demonstration and Training."

3.7 SEQUENCE OF OPERATION

- A. Computer room cooling unit shall be primary source of cooling. VAV box shall be back-up source of cooling. VAV cooling set point shall be 5 degrees F (adj) higher than CRV set point. If CRV is unavailable to maintain set point after hours or in unoccupied mode, central AHU shall be switched to occupied, and VAV shall operate to maintain set point.

END OF SECTION 15900

SECTION 15950 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes TAB to produce design objectives for the following:

- 1. Existing VAV box
- 2. New computer room cooling unit.

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- E. NC: Noise criteria.
- F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- G. RC: Room criteria.
- H. Report Forms: Test data sheets for recording test data in logical order.
- I. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- J. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

- K. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- L. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- M. TAB: Testing, adjusting, and balancing.
- N. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- O. Test: A procedure to determine quantitative performance of systems or equipment.
- P. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

- A. Qualification Data: Within 15 days from Contractor's Notice to Proceed, submit 4 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

1.5 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by AABC or NEBB.
- B. Approved TAB agencies:
 - 1. Bonneville Test and Balance.
 - 2. BTC Services.
 - 3. Certified Test and Balance.
 - 4. Danis Test and Balance.
 - 5. Intermountain Test and Balance.
 - 6. RS Analysis.
 - 7. Technical Specialties.
 - 8. Testing and Balancing, Inc.

1.6 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

- A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS

(Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
 - 1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
 - 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.

- C. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- D. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- E. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- F. Examine system and equipment test reports.
- G. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- H. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- I. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- K. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- L. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.

5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 6. Sensors are located to sense only the intended conditions.
 7. Sequence of operation for control modes is according to the Contract Documents.
 8. Controller set points are set at indicated values.
 9. Interlocked systems are operating.
 10. Changeover from heating to cooling mode occurs according to indicated values.
- M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
 2. Air Outlets and Inlets: 0 to minus 10 percent.
 3. Heating-Water Flow Rate: 0 to minus 10 percent.
 4. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.3 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

END OF SECTION 15950

SECTION 16050 – BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Provide all items, articles, materials, equipment, operations and/or methods listed, mentioned, shown and/or scheduled on the drawings and/or in these specifications, including all labor, services, permits, fees, utility charges, and incidentals necessary and required to perform and complete the electrical work described in this Division. Apply for all permits early in the project to avoid problems due to code revisions.
- B. See the contract conditions (general and supplementary) and Division 1 for requirements concerning this Division including, but not limited to, submittals, shop drawings, substitution requests, change orders, maintenance manuals, record drawings, coordination, permits, record documents and guarantees.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

- A. Mechanical equipment motors to be furnished under another Division but connected under this Division. Starters to be mounted and connected by this Division, but furnished by another Division unless otherwise noted on the electrical drawings. Motor control centers shall be furnished and installed under this Division of the work. Verify and coordinate all equipment locations and electrical characteristics with other trades involved in the work. Coordination shall be done prior to rough-in or ordering equipment.
- B. Control wiring for mechanical equipment beyond provisions shown on the Electrical Drawings shall be performed under another Division of the work.

1.3 QUALITY ASSURANCE:

- A. Do all work in accordance with regulations of serving electric utility, telephone utility, cable TV utility, National Electrical Code, state and local codes and amendments, National Fire Codes, and all other applicable codes.

1.4 PROJECT CONDITIONS:

- A. The Contractor shall inspect the job site prior to bidding and familiarize himself with existing conditions which will affect the work. Prior to start of work, obtain "As built", "Record", or other Drawings showing existing underground utilities.
- B. Electrical drawings are diagrammatic indicating approximate location of outlets, lighting fixtures, electrical equipment, etc. Consult the Architectural, Structural, and Mechanical Drawings to avoid conflicts with equipment, structural members, etc. When required make all deviations from Drawings to make the work conform to the building as constructed, and to related work of others. Minor relocations ordered prior to installation may be made without added cost to Owner.

- C. Call to the attention of the Engineer any error, omission, conflict or discrepancy in Drawings and/or Specifications. Do not proceed with any questionable items of work until clarification of same has been made.
- D. Under no conditions are beams, girders, footings or columns to be cut for electrical items unless so shown on Drawings or written approval obtained from the Engineer.
- E. Verify the physical dimensions of each item of electrical equipment to fit the available space and promptly notify the Engineer prior to roughing-in if conflicts appear. Coordination of equipment to the available space and to the access routes through the construction shall be the Contractor's responsibility.

1.5 SHOP DRAWINGS:

- A. Prior to ordering equipment, and prior to Contractor's first application for payment, the Contractor shall, within 14 days after award of this work, submit six (6) complete shop drawings, neatly bound in 3-ring binder form, with indexed tabs, to the Engineer, of materials and equipment he proposes to furnish. It is preferred that all sections be submitted at once, however, in the event that one or more sections need approvals quickly and others are not prepared yet, the Engineer will agree to review the individual section submittals needing immediate approval. However, each individual submittal section must be complete, and remaining submittals that are not a rush shall be submitted all in one package as quickly as possible. Submitting individual sections over many weeks/months will not be tolerated.
- B. List shall bear Contractor's stamp, signature or other means to show that he has inspected same and certified that submitted material is correct in regard to quantity, size, dimension, quality and is coordinated with the Contract Documents.
- C. See individual sections within this Division for products requiring submittal.
- D. Each shop drawing submittal shall be prepared by the manufacturer, and shall clearly show manufacturer's name, catalog numbers, pictures, details, layout, type, size, rating, style, and all options identified in a permanent fashion. Specific items or options shall be permanently marked on sheets containing more than one option – do not rely on the Engineer to mark options. Yellow highlight will not be an acceptable means of marking.
- E. Large equipment drawings such as UPS systems, generators, transformers, switchboards, and similar large equipment shall include the size, weight, seismic rating, emissions data, elevation, and wiring diagrams in addition to the product data.
- F. Some sections of this Division may require shop drawings prepared on full size floor plans in AutoCAD or other CAD software. Where required, contact the Engineer for the latest version of the floorplans and match the size and scale of the construction drawings. Drawings delivered to the contractor from the Architect/Engineer may not include addenda changes. Contractor shall only use floor plans for purposes of the construction on this job, and not for any other use or reuse. Add any required addenda items prior to finishing submittals.

- G. Provide complete materials (all materials) list at the beginning of each tabbed section showing "Specification Section", "Material Item", "Manufacturer's Name and Catalog Number", and all pertinent data.
- H. Provide samples were required in individual sections of this Division.
- I. Contractor agrees that Shop Drawing Submittals processed by the Engineer are not Change Orders; that the purpose of Shop Drawing Submittals by the Contractor is to demonstrate to the Engineer that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use.
- J. Contractor further agrees that if deviations, discrepancies or conflicts between Shop Drawings and Specifications are discovered either prior to or after Shop Drawing Submittals are processed by the Engineer, the design Drawings and Specifications shall control and shall be followed.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. All materials shall be new and bear manufacturer's name, model number, electrical characteristics and other identification. All equipment to be U.L. approved or listed by another testing agency approved by authorities having jurisdiction.
- B. Material and equipment shall be standard product of manufacturer regularly engaged in production of similar material for at least five years (unless specifically exempted) and shall be manufacturer's latest design.
- C. If the description of a product is in conflict with the product as specified in the catalog number, the description shall generally take precedence. Contact the Engineer for clarification if this occurs.
- D. All equipment for essential or life safety systems must be rated and certified for the appropriate seismic design category or seismic use group for the installed location.

2.2 DISCONNECTS:

- A. Safety and disconnect switches to be General duty quick-make, quick-break, dual rated, lockable, and of such electrical characteristics as required for the load served. Switches to have defeatable cover interlock.
- B. Fuse clips shall accept Class R or Class L fuses if required. Motor rated toggle switches equal to Square D Class 2510, type F with thermal overloads may be used as motor disconnects in dry locations.
- C. Disconnect switches required by code shall be installed whether or not specifically shown on the Drawings. Disconnect switches for refrigeration equipment and multiple motor HVAC equipment shall be fusible type.

- D. Safety and disconnect switches (fuse, non-fuse or circuit-breaker type) to be of same manufacturer as switchgear and panelboards.

2.3 FUSES:

- A. Provide fuses as indicated on the drawings, sized per NEC, or as required by the equipment manufacturer, whichever provides maximum protection, for a fully operational system.
- B. All fuses shall be furnished of the same manufacturer.
- C. All fuses shall be installed by the electrical contractor at job-site and only when equipment is to be energized. Fuses shall not be installed during shipment.
- D. All fuses to be 200,000 AIC, Current-limiting, U.L., Time Delay, Dual-element Type as follows:
 - For feeders 601 Amps to 6000 Amps:
Class L, KRP-C, KLPC, & A4BQ
 - For feeders 600 Amps and less:
Class RKk-1 for 600 volt; LPS-RK, LLS-RK, & A6D-R
Class RK-1 for 250 volt; LPN-RK, LLN-RK, & A2D-R
Class J; JHC, JTD, & AJT
 - For motor circuits beyond the main and subdistribution boards, 600 volt and below:
Class RK-5 for 600 volt; FRS-R, FLS-R, & TRS-R
Class RK-5 for 250 volt; FRN-R, FLN-R, & TR-R
- E. SPARE PARTS: Provide 10% spare fuses, but not less than 3 of any one size and type.
- F. Provide Spare Fuse Cabinet(s), #SFC, #LSFC, & ATFC as required. Install cabinet(s) in Main Electrical Room.
- G. Approved Manufacturers, with catalog numbers listed in order: Bussman, Littelfuse, Ferraz Shawmut.
- H. If the electrical contractor wishes to furnish materials other than those specified, a written request, along with a complete short circuit and selective coordination study, shall be submitted to the engineer for evaluation at least 8 days prior to the bid date. If the engineers evaluation indicates acceptance, a written addendum will be issued listing the other acceptable manufacturer.

2.4 BOXES:

- A. Outlet and junction boxes shall be sized in accordance with code requirements or as noted on the drawings.
- B. Unless otherwise specified or shown on the drawings, all outlet boxes for new work shall be galvanized steel knockout, outlet boxes. Gangable boxes are not acceptable. Outlet boxes shall not be smaller than 4" square and 1-1/2 inches in depth, unless otherwise noted. All outlet box covers, rings, or other fittings shall be galvanized. Boxes which are

exposed to the weather shall be cast metal. Outlet boxes for phone and data outlets shall be 2.5" deep boxes.

- C. Outlet boxes shall be designed for the intended use, and shall be installed flush with finish surface lines or not more than 1/8 inch back and shall be level and plumb. Long screws with spacers or shims for mounting devices are not acceptable. No combustible materials shall be exposed to wiring at outlets.
- D. Outlet boxes on opposite sides of fire or sound isolating partitions shall have a minimum horizontal separation of 24". Back to back boxes are not permitted in any walls.
- I. Floor boxes which contain voice and data cable often are shown with an empty conduit running up a wall and stubbing into the ceiling. Where no conduit is shown, stub a 1" conduit out the bottom of the low voltage section of the box and into the ceiling space of the floor below.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION METHODS:

- A. All items, articles, materials, and equipment specified under this Division shall be installed per the manufacturer's installation instructions. Where the manufacturer's instructions are in conflict with the directions provided elsewhere in this Contract, the Engineer shall be notified prior to beginning rough-in.
- B. Cutting or notching shall be kept to an absolute minimum and done when, and in a method approved by the Engineer. Patch and correct finished surfaces damaged by electrical work.
- C. Relays, panels, cabinets and equipment shall be level and plumb and installed parallel with structural building lines. All equipment and enclosures shall fit neatly without gaps, openings, or distortions. Provide approved devices for closing all unused openings.
- D. Arrange circuit wiring as shown on the Drawings and do not alter or combine runs or homeruns without the specific approval of the Engineer. Feeder runs shall not be recombined or altered.
- E. Contactors, transformers, starters and similar noise producing devices shall not be placed on walls which are common to occupied space.
- F. Ballasts, contactors, starters, transformers and like equipment which are found to be noticeably noisier than other similar equipment on the project will be deemed defective and shall be replaced.
- G. In general, the mounting heights shall be as noted on the Drawings, or as listed below, the Architectural Interior Elevations and drawing notes taking precedence. Where no heights are indicated, request clarification from the Engineer. Consult the Architectural, Mechanical and Structural drawings to avoid conflicts prior to roughing-in and for exact locations. All dimensions are to the center of the device unless otherwise noted. Lighting

dimensions are to the bottom of suspended fixtures and center of wall mounted fixtures unless otherwise noted.

Light Switches	45 inches
Convenience Receptacles	18 inches
Panelboard top	72 inches
Fire Alarm Signals	96 inches to top (but at least 6" below ceiling)
Fire Call Stations	45 inches
Data/Telephone Outlets	18 inches
Receptacles and Outlets Over Counters	8 inches above counter or 3 inches above backsplash, whichever is greater.

- H. Where raceways penetrate floors, ceilings, ducts, chases, and fire walls, provide fire stopping to maintain integrity of the fire assembly. Firestopping method shall be approved by the Code Authority having jurisdiction.
- I. All materials and equipment installed under this work shall be properly and adequately supported from the building structure except where ceiling construction or other provisions are specifically designed to support them. Support systems shall provide a safety factor of four. This shall apply to chains, hangers, anchors, clamps, screws, structural iron, and all other hardware and appurtenances associated with the support system.
- J. Rough-in for communications outlets for phone and data systems shall consist of a 4" square deep (4SD) box with a single gang mud ring. Provide a .75" conduit for wall phones and a 1" conduit for combination voice and data outlets to an accessible ceiling space. Conduit shall be terminated above the ceiling in a bushing and a pull string installed.
- K. Maintain the following minimum separations from voice and data cables. Power conduit - 12", transformers and motors - 40", fluorescent lighting - 12". Coordinate with the voice and data installer to assure these separations are met.
- L. All new floor mounted electrical equipment including, but not limited to: Transformers, Switchboards, MCC's, Switchgear, Switches, UPS, PDU's and Generators; shall have concrete housekeeping pads installed. All Concrete pads shall be as indicated on the drawings or 4 inches high above finished floor, extending to 4 inches beyond the width and depth of the Equipment base; pad dimensions indicated on the drawings shall take precedence in all cases.

3.3 LOW VOLTAGE WIRING METHODS:

- A. Provide conduit homeruns complete for all low voltage systems. Plenum cabling will not be acceptable.
- B. Conduit shall be concealed in all finished spaces and shall be run parallel to structural lines and supported at minimum 5' intervals from structure.
- C. Provide a box, plaster ring, and conduit with insulated bushing from each wall or floor outlet. Conduit shall be minimum 3/4" for telephone, minimum 1" combined voice and data outlets, and sized as needed for other systems. Drawings notes shall take

precedence. Raceways for phone and data cable shall be sized based on the number of cables in accordance with the following guidelines.

- 3/4" conduit - max 4cables
- 1" conduit - max 8 cables
- 1.25" conduit - max 14 cables
- 1.5" conduit - max 19 cables
- 2" conduit - max 32 cables

- D. Furnish and install all necessary sleeves and raceways to permit the installation of signal cables (specific attention is called to non-contiguous ceiling spaces) to the appropriate equipment termination point. Provide sleeves through all fire-rated walls and partitions. No outlets of any type shall be left without a raceway system or accessible ceiling path to their termination point. Verify that raceway sizes and quantities are appropriate and will have at least 50% spare capacity after all cables are initially installed. Provide at least one empty spare conduit to each area, sized to handle future needs.

3.4 LABELING:

- A. Clearly and properly label the complete electrical system to indicate the loads served or the function of each item of equipment provided under this work.
- B. Nameplates shall be 1/16 inch thick, laminated three-ply plastic, center-ply white, outer-ply black "Lamicoid" or equal. Letters shall be formed by engraving outer black ply, exposing white center-ply, and shall be minimum 5/8 inch high. Nameplates shall be secured with screws or pop rivets.
- C. Provide a master nameplate at the main distribution to identify the project, the Engineer and the date. Clearly label switchboards with engraved nameplates to identify each load served.
- D. Label all electrical contactors, relays, time switches, transformers, etc. with an engraved nameplate corresponding to the labeling in the main, subdistribution, or branch panel serving the device or apparatus.
- E. Provide typewritten branch panel schedules with protective clear, transparent covers accounting for every breaker installed. Use actual room designations assigned by name or number near completion of the work, and not the designations shown on drawings.
- F. Identify branch panels with engraved nameplate corresponding with distribution panel labeling. Mount labels inside door for flush panels, and on the face of the door for surface panels. No brand labels or other marking shall be on the outside of the panels. Where changes are made in existing panels, distribution boards, etc., provide new labeling and schedules to accurately reflect the changes.

3.5 SAFETY:

- A. The Engineer has not been retained or compensated to provide design and construction review services relating to the Contractor's safety precautions or to means, methods, techniques, sequences or procedures required for the contractor to perform the work.

3.6 DEMOLITION:

- A. It is the intent of these specifications to require the contractor to make all necessary adjustments to the electrical system, required to meet code, and accommodate installation of the new and remodeled work.
- B. Remove all existing fixtures, clocks, switches, receptacles, raceways, and other electrical equipment and devices and associated wiring from walls, ceilings, floors, and other surfaces scheduled for remodeling, relocation, or demolition unless specifically shown as retained or relocated on the drawings. If existing walls, ceiling, floors, etc. are moved, extend existing devices, fixtures, and circuiting to the new location.
- C. Disconnect all existing mechanical equipment scheduled for removal or relocation. See mechanical drawings for scope of work. Remove abandoned raceways and cables. Relabel panels and motor control centers to reflect changes.
- D. If existing junction boxes will be made inaccessible, or if abandoned outlets serve as feed through boxes for other existing electrical equipment which is being retained, new conduit and wire shall be provided to bypass the abandoned outlets. If existing conduits pass through or are mounted on partitions or ceilings which are being removed or remodeled, new conduit and wire shall be provided to route around the ceiling or wall and maintain service to the existing load.
- E. Extend circuiting and devices in all existing walls to be furred out.
- F. Locations of items shown on the drawings as existing are partially based on as-built and other drawings which may contain errors. The Contractor shall verify the correctness of the information shown prior to bidding and provide such labor and material as is necessary to accomplish the intent of the contract documents. The plans may show some demolition conditions, but are not intended to show all of them.
- G. All materials accumulated during the demolition process are the Owners property and shall be removed from the job site as directed by the Owner. If owner does not wish to salvage materials, contractor shall remove from jobsite and dispose, or recycle materials at contractor's discretion, in a lawful manner.
- H. Where changes are made in existing panels, distribution boards, etc., provide new labeling and schedules to accurately reflect the changes.
- I. Demolish and dispose of hazardous materials in a lawful manner, such as PCB containing transformers or ballasts, mercury containing lamps, or materials containing lead. All costs for proper disposal shall be paid by the contractor unless specified elsewhere in the general conditions.

3.7 POWER INTERRUPTIONS:

- A. Keep outages to occupied areas to a minimum and prearrange all outages with the Owner's representative and utilities involved. Requests for outages shall state the specific dates and hours and the maximum durations, with the outages kept to these specified times. When power interruptions will last longer than 5 minutes and cover more

than 10% of the building, or affect public areas, they shall be performed on the weekends between 1 and 5 AM.

- B. Contractor shall coordinate with the Owner so that work can be scheduled not to interrupt operations, normal activities, building access, etc. Coordinate work with other crafts for proper scheduling.
- C. No circuits shall be turned off without prior approval from owner. Coordinate with the Owner any interruptions which affect the operation of the remaining portions of the facility.
- D. This contractor will be liable for any damages resulting from unscheduled outages or for those not confined to the preapproved times. Include all costs for overtime labor as necessary to maintain electrical services in the initial bid proposal. Temporary wiring and facilities, if used, shall be removed and the site left clean before final acceptance. Requests for outages must be submitted at least (5) days prior to intended shutdown time.
- E. Include in bid cost of minimum temporary power for Fire Alarm System, Security, Telephone/Data equipment and any other equipment designated by Owner, during time when primary building power has been interrupted.

3.8 GROUNDING:

- A. Ground all electric equipment, raceways and enclosures in accordance with code rules and established safety practices. Provide a single main grounding point where grounding conductors from the Grounding Electrode System ground rods, ground grids, water pipes, main switchgear, etc. may be terminated.
- B. Grounds shall be installed where accessible for future inspection and servicing. Where ground connections are made underground or in inaccessible locations, they shall be made using an exothermic weld process, Cadweld or equivalent, or Ampact pressure connectors.
- C. Install grounding conductors in approved metallic raceways unless specifically shown or specified otherwise. Bond at each end and at all intervening boxes and enclosures between the service equipment and grounding electrode.
- D. No. 8 and smaller grounding conductors shall have green insulation. No. 6 and larger shall be marked with green colored tape at each end and at every box, panel, switchboard, or point where conductor is accessible.
- E. Provide a #6 grounding conductor to all telephone, data processing and sound system terminals throughout project. Provide a wall mounted busbar assembly equivalent to Square D Class 1630-PK15GTA/PKGTAB.

3.9 TVSS (Transient Voltage Surge Suppression) INSTALLATIONS

- A. When TVSS units are specified, they are to be shipped with complete installation instructions which are to be followed in detail. The manufacturer's representative is always to be contacted and is to supervise the TVSS installation.

B. Supplemental installation information is as follows:

1. Use the breaker space closest to the neutral bus. Nipple the suppressor to the panel where the suppressor can be installed so as to keep both the hot leads and the neutral lead as short and straight as possible from the suppressor to the breakers and the neutral bus.
2. The best performance is achieved with the shortest leads and neutral. All efforts within the code should be used to minimize the lead lengths. Ideally the leads should be less than eight inches long. Each inch of lead above six inches will add approximately 20 volts to the quoted let-through voltage. Cut the leads down to the shortest size that will allow installation.
3. If the neutral bus is out of reach of the leads, then a #4 AWG conductor is to be run from the remote neutral bus to a lug near the suppressor, and the lead from the suppressor should be cut as short as possible.
4. The ground is to be connected to the case of the panel (equipment ground only). Do not connect the suppressor ground wire to an isolated ground (IG) bus.

3.10 EQUIPMENT CONNECTIONS:

- A. The location and method for connecting to each item of equipment shall be verified prior to roughing-in. The voltage and phase of each item of equipment shall be checked before connecting. Motor rotations shall be made in the proper direction. Pump motors are not to be test run until liquid is in the system and proper lubrication to all bearings in unit is checked.
- B. Conduit, wire and circuit breaker sizes for mechanical, elevator and similar equipment are based on the equipment ratings of one manufacturer. The equipment actually furnished may have entirely different electrical characteristics. Conduit, wire, circuit breakers, disconnects, etc. shall not be ordered or installed until exact electrical requirements are obtained. Responsibility for this coordination rests with the Contractor.

3.11 SEISMIC BRACING:

- A. Furnish and install all seismic bracing of equipment, feeders, lighting fixtures, and other electrical items in accordance with prevailing codes. Refer to ASCE 7-02, section 9.6 for calculation methods. Provide and submit the required designs, calculations, certifications, and stamped drawings to the authority having jurisdiction and obtain their approval prior to installation or fabrication.
- B. Where conduit, cable trays, or busducts are attached to structures where they cross a seismic isolation interface, the electrical components shall be designed to accommodate the seismic relative displacement.

3.12 PAINTING:

- A. All electrical equipment and conduit exposed in finished areas and on exterior walls are to be painted to match surrounding surfaces.

B. Contractor shall coordinate the timing of painting requirements.

C. Refer to Architectural specifications for methods and materials.

3.13 PROJECT RECORD DOCUMENTS:

A. Maintenance of Documents:

1. Maintain at Jobsite, One Record Copy of: Contract Drawings, Specifications, Addenda, Reviewed Shop Drawings, Change Orders, Other Modifications to Contract and Field Test Records.
2. Keep apart from documents used for construction.
3. Keep documents available at all times for inspection by Engineer.

B. Recording:

1. Label each document "PROJECT RECORD."
2. Keep record documents current. Do not permanently conceal any work until required information has been recorded.
3. Contract Drawings, legibly mark to record actual construction; including but not limited to the following:
 - a. Depths of various elements; locations of underground items, with dimensions to building walls and corners; changes of dimensions and details; changes made by Addendum, Field Orders or Change Order.
 - b. Specifications and Addenda; Legibly mark each Section to record changes made by Addendum, Field Order or Change Order.

C. As-Built Submittals:

1. At completion of project, transfer changes, addenda items, variations from drawings, exact routes of all feeders and service conduits, and locations of stubbed conduits to clean new prints and specifications which will be supplied by the Engineer and deliver to the Engineer as "As-reported Record" drawings. Include dimensions to all buried or concealed conduits to permanent structures.

D. Operation and Maintenance Manuals

1. At completion of project, prepare Operation and Maintenance Manuals with operation and Maintenance Data, contractors warranties, and copies of approved electrical permits. Include corrected copies of original submittals and shop drawings.
2. See Division 1 for additional requirements.

3.14 WARRANTIES:

- A. Provide a minimum 1 year warranty on all electrical equipment, devices, labor, and work by Division 16 whether specified or not.
- B. Provide warranties greater than 1 year as specified in other sections where stated. The warranty requirement most stringent shall be used where conflicts arise.
- C. The systems listed below require warranties exceeding the minimum warranty:
 - 1. TVSS; 5 years refer to Section – 16478.
 - 2. Lighting; 5 years for ballasts refer to Section – 16500
 - 3. Occupancy Sensed Lighting Control; 5 years refer to Section – 16550.
- D. Provide copies of all warranties to the owner upon completion of the project.

3.15 COMPLETION:

- A. Complete each system as shown or specified herein and place in operation except where only roughing-in or partial systems are called for. Each system shall be tested and left in proper operation free of faults, shorts or unintentional grounds. Demonstrate system in the presence of the Engineer, the Owner or their representative when requested.

3.16 FINAL OBSERVATION:

- A. Contractor shall submit written certification that:
 - 1. Contract Documents have been reviewed.
 - 2. Contractor has inspected Project for compliance with Contract Documents.
 - 3. Work has been completed in accordance with Contract Documents.
 - 4. Equipment and Systems have been tested and are operational.
 - 5. Project is completed and ready for final inspection.
- B. Engineer will make final inspection as soon as possible after receipt of Certification.
- C. Should Engineer consider that work is finally complete in accordance with Contract Document requirements, Contractor shall make Contract Closeout submittals.
- D. Should Engineer consider that work is not finally complete:
 - 1. He will so notify Contractor, stating reasons.

2. Contractor shall take immediate steps to remedy deficiencies, and send second written notice to Engineer certifying that work is complete.
 3. Engineer will reinspect work.
- E. The Engineer will make two final inspections. The first will determine deficiencies and errors in the work and the second will determine whether or not the noted deficiencies and errors have been satisfactorily corrected.
- F. If additional inspections are required because of the Contractor's failure to complete the deficiencies and errors prior to the second inspection, costs for the successive inspections will be back-charged to the Contractor by the Owner, who, in turn, will reimburse the Engineer. Charges will be based as follows:
1. Engineer time at current billing rates.
 2. Travel time, and all other expenses incurred in making inspections.
- G. Contractor to provide one (1) journeyman, tools, meters, instruments and other test equipment required by Engineer. Contractor to remove and replace trims, covers, fixtures, etc., for Engineer to review and test materials, systems, methods and workmanship. (Example: Removing switchboard and panel covers to take voltage/amp readings, review connections and wire size, etc.)

END OF SECTION

SECTION 16120 – WIRES & CABLES

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Provide all wires and cables as herein specified and shown on the associated drawings.

1.2 QUALITY ASSURANCE:

- A. All wire and cable shall conform to Code and shall meet all ASTM specifications.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. No. 10 and 12 AWG conductors shall be Type "THHN" insulated, stranded or soft drawn solid copper. No. 8 AWG and larger conductors shall be Type "THHN" insulated, soft drawn, Class B stranded copper. Minimum conductor size shall be No. 12 AWG unless otherwise noted.
- B. Where adverse conductor exposure exists, code approved insulation suitable for the conditions encountered shall be used unless shown otherwise on the Drawings.
- C. Wire and cable shall be new, shall have grade of insulation, voltage and manufacturer's name permanently marked on outer covering at regular intervals and shall be delivered in complete coils or reels with identifying size and insulation tags.

2.2 ALUMINUM AND/OR METAL CLAD (MC) CABLING OPTIONS:

- A. Aluminum and MC Cabling Not acceptable – Provide Copper Only Feeder Wire.

2.3 COLOR CODE:

- A. All wire shall be fully colored in sizes 12 and 10 AWG, and color banded at each end and at all junction and pull boxes for size 8 AWG and larger.
- B. Color Code throughout the project shall be:
 - 1. 208Y/120V System
 - Phase A Black
 - Phase B Red
 - Phase C Blue
 - Neutral White
 - Equipment Ground Green

Isolated Ground

Green w/yellow stripe #12 & #10
Green and Yellow bands #8 and up

PART 3 - EXECUTION

3.1 SPLICES AND TERMINATIONS:

- A. Splices are to be made up complete promptly after wire installation. Single wire pigtails shall be provided for fixture and device connections. Wirenuts may be used for fixture wire connections to single wire circuit conductor pigtails.
- B. Splices shall utilize Scotch "Hyflex" or "Ideal" wing nut connector installed properly. Splices for No. 8 and larger wires shall be made with mechanically applied pressure type connectors. All taped joints shall be with "Scotch 33+" or equal, applied in half-lap layers without stretching to deform.
- C. Insulation shall be removed with a stripping tool designed specifically for that purpose. A pocket knife is not an acceptable tool. All conductors shall be left nick-free.
- D. Thermoplastic insulated wire and cable shall not be installed or handled in temperatures below +14 degrees F (-10 C). Cross-linked polyethylene insulated wire and cable may be installed to -40 degrees F (-40 C).

END OF SECTION

SECTION 16130 - RACEWAYS

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Provide all raceways, wireways and associated fittings as herein specified and shown on the associated drawings.

1.2 APPLICATION:

- A. Electric metallic tubing (EMT), galvanized rigid conduit (GRC), intermediate metal conduit (IMC), flexible metal conduit, and PVC conduit may be used.
- B. Schedule 40 PVC conduit may only be used below grade and below slabs on grade. PVC may not be used above grade. Conduits larger than 1 inch shall be run below the slab.
- C. GRC and IMC shall be used in locations subject to mechanical injury and for service conduit under buildings or concrete slabs.
- D. EMT may be used only in dry and protected locations.
- E. Flexible metal conduit will be permitted only where flexibility is necessary. Exceptions are connections to recessed light fixtures and work fished into existing concealed dry locations, and wood frame construction. Flexible metal conduit shall be used for connection to all equipment subject to movement or vibration such as motors and transformers.
- F. Drawing notes requiring a specific type of raceway shall take precedence over the specifications.
- G. Surface metal raceways equal to Wiremold (700 series unless noted otherwise) may be used only where specifically called for on the drawings or in the specifications. Such installation shall be directed by Architect.
- H. Electrical wiring shall be in U.L. approved raceways and enclosures throughout.
- I. 4" and larger conduits intended for use on primary services and communications services shall have minimum 48" radius sweep on all bends.

PART 2 - PRODUCTS

2.1 FITTINGS:

- A. GRC and IMC shall be coupled and terminated with threaded fittings. Ends shall be bushed with insulating bushings.

- B. Connectors and couplings for EMT shall be steel concrete tight set screw type with insulated throats on connectors. Connectors larger than 1-1/4 inch shall be insulating bushing.

2.2 CONDUIT

- A. Provide EMT in 3/4 inch minimum size.
- B. Provide PVC conduit (where installed below grade or below slab on grade) in one inch minimum size.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Provide pull boxes where shown or required to limit the number of bends in any run to not more than three 90 degree bends. Use code gauge galvanized sheet steel boxes of code required size with removable covers, installed so that covers will be accessible after work is completed. Verify with the Architect any locations in finished areas.
- B. Conceal all wiring in finished spaces. Exposed raceways shall be parallel to structural lines.
- C. Support suspended feeder conduits by metal ring or trapeze hangers with threaded steel rods. If a large number of suspended feeders are grouped together, the contractor shall review the layout with the structural engineer and obtain approval for the proposed layout.
- D. Conduit shall be adequately braced for Seismic Restraint, as required per ASCE 7-02, Section 9.6, latest edition.
- E. Expansion Joints:
 - 1. All conduits crossing expansion joints where cast in concrete shall be provided with expansion-deflection fittings, equivalent to OZ/Gedney AXDX, installed per manufacturers recommendations.
 - 2. All conduits three inches and larger where not cast in concrete shall be rigidly secured to the building structure on opposite sides of a building expansion joint with an expansion-deflection fitting across the joint, equivalent to OZ/Gedney AXDX, installed per manufacturer's recommendations.
 - 3. All conduits less than three inches where not cast in concrete shall be provided with junction boxes securely fastened on both sides of the expansion joint, connected together with 15 inches of slack (a minimum of 15 inches longer than the straight line length) flexible conduit and copper green ground bonding jumper. In lieu of this flexible conduit, an expansion-deflection fitting, as indicated for conduits three inch and larger, may be installed.
- F. Seismic Joints:

1. No conduits cast in concrete shall be allowed to cross a seismic joint.
 2. All conduits shall be provided with junction boxes securely fastened on both sides of the seismic joint, connected together with 15 inches of slack (a minimum of 15 inches longer than the straight line length) flexible conduit and copper green ground bonding jumper. Prior to installation, verify with Architect that the 15 inches is adequate for the designed movement, and if not, increase this length as required.
- G. Conduit stubbed from a concrete slab or wall to serve an outlet under a table or to supply a machine shall have a rigid conduit coupling flush with the surface of the slab. Provide plug where conduit is to be used in future.
- H. Conduits in above grade slabs shall be located in the middle of the slab. The maximum size, spacing, and location of conduits in post-tensioned slabs shall be subject to approval by the structural engineer. Conduits larger than one inch shall not be run in slabs.
- I. Provide a ground wire sized per code in all conduit.
- J. Where PVC conduit is below building slab on grade, conduit must be installed to be at least 2 inches below the slab. Provide 2 inches of sand or pea sized gravel to cover conduit. Protect conduit from vehicle traffic and construction traffic prior to concrete pour. Conduit poured inside the slab for slab on grade construction is not acceptable.
- K. Elbows larger than 30 degrees and one inch shall be galvanized rigid conduit, wrapped with PVC tape.
- L. Provide a ground wire sized per code in all PVC conduits. Conductor quantities indicated in conduits do not include ground wires unless otherwise noted.
- M. Provide trenching, backfilling, compaction, re-paving or other site restoration as required by the work done in this division. Minimum trench depth shall be 24" unless otherwise noted.
- N. Install a detectable 6 inch wide yellow vinyl tape with letter "Caution: Buried Electrical Line Below" 18 inches above all buried service conduit and wire not under structures.
- O. Backfill material for all trenches under paved areas shall be coarse sand or crushed rock, installed in layers not to exceed eight inches and compacted to 95% of maximum density at optimum moisture content to preclude subsequent settlement. Compaction by water method. The top 18 inches of trenches in landscaped or grassed areas shall be backfilled with native soil and tamped.
- P. Conduits piercing a building waterproof membrane shall be provided with flanges, using two neoprene washers, one washer on each side of membrane, between each flange and membrane.
- Q. All underground conduits which enter the building shall be sloped to drain away from the building and shall be water sealed to prevent moisture from passing through the conduit

into the building. All joints to be threaded and taped or glued to prevent entry of water into the conduits.

- R. All underground conduits entering the building shall be poured-in-place, or provided with watertight conduit sleeves and rubber seals, Link-seal system by Thunderline Corporation or equivalent.
- S. Raceways shall be left clean and free of debris.
- T. Provide a pull string in all empty conduits.
- U. All conduit leaving building envelope (e.g. site lighting, roof mounted HVAC requirement, etc.) to be 0.75" minimum.

END OF SECTION

SECTION 16140 – SWITCHES & RECEPTACLES

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Provide all switches, receptacles, and other devices as herein specified and shown on the associated drawings.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Bryant, Arrow-Hart, Eagle, LaGrande, General Electric, Leviton, Hubbell are acceptable.

2.2 MATERIALS:

- A. The following list of wiring devices covers the most commonly specified items and establishes the grade of device. Should the Drawings indicate a device other than those listed herein without reference to catalog number, such device shall be of the same grade and manufacturer as like devices.

Single Pole Switches	Hubbell #1221
Duplex Receptacles - 20 amp	Hubbell #5362
Where required by Code and/or indicated on drawings	
Hospital-grade Duplex Receptacle	Hubbell #8300
Safety Duplex Receptacle	Hubbell #HBLSG 63H
Duplex Receptacles-Isolated Ground	Hubbell #5362-IG, Orange
Switch with Pilot	LaGrande #20AC1
Dimmers	Lightolier, Neptune Momentum series

- B. All wiring devices and plates to be specification grade. Receptacles shall be mounted vertically with the ground pin down unless otherwise noted.
- C. Color of devices and plates to be selected by Architect. Provide stainless steel finish for all plates. Wood paneled walls shall have brown devices and plates. Restrooms, and food preparation areas to have 302 stainless steel plates. Receptacles fed by emergency circuits shall have red devices with "EMERGENCY POWER" engraved in white letters on a red nylon plate with panel and circuit designation engraved on plate. Receptacles fed by UPS circuits shall have yellow devices with "UPS POWER" engraved in white letters on a red nylon plate with panel and circuit designation engraved on plate.
- D. Flush floor receptacles to be duplex and to have stainless steel, hinged flap lids. Provide carpet flanges in carpeted floors. (See 16050, 2.4, E.)

- E. Wet location and/or weatherproof receptacles shall be in a weatherproof enclosure, the integrity of which is not affected when the receptacle is in use (attachment plug cap inserted), UL labeled and listed "Suitable For Wet Locations While In Use". Provide enclosure with stainless steel screws, gasket between enclosure and mounting surface and between cover and base, clear impact resistant UV stabilized polycarbonate as manufactured by TayMac Corporation or accepted equivalent.

PART 3 - EXECUTION

3.1 GENERAL:

- A. Provide a separate GFI type receptacle for each receptacle noted on plans as GFI. Standard receptacles fed from an up-stream GFI type receptacle are not acceptable.
- B. Install outlets and switches in a neat manner.
- C. Extend mudrings to flush out with surrounding wood panels and walls.
- D. Faceplates, devices, and boxes shall be square with floor, and door lines.
- E. Devices to be installed flush with faceplate.

3.2 LABELING:

- A. Where switches control remote lighting or power outlets, or where switches in the same outlet (two or more) serve different purposes, such as light, power, intercom, etc. or different areas, such as corridor and outside, furnish engraved plates with 1/8 inch black letters indicating function of each switch or outlet.

END OF SECTION

SECTION 16470 - PANELBOARDS

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Provide all branch circuit panelboards as herein specified and shown on the drawings.

1.2 SUBMITTALS:

- A. Submit complete and descriptive shop drawings indicating dimensions and compliance with the specifications herein. Submit in accordance with Section 01300.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Square D, Siemens, General Electric, Cutler-Hammer/Westinghouse
- B. Requests for substitution of other products will be considered if submitted in accordance with Section 01630.

2.2 EQUIPMENT:

- A. Panels shall be factory pre-assembled using bolt-on circuit breakers, equivalent to Square D NQOD series. Separate feeder lugs shall be provided for each feeder conductor.
- B. Breakers in branch panelboards shall be not less than 3/4 inch on centers. Each breaker shall be securely fastened to prevent movement and trims shall fit neatly and tightly to the breaker assembly. Two and three pole breakers shall be single breaker assembly rather than two or three single pole breakers with the handles tied together externally.
- C. Panel finish shall be a flat, light gray finish suitable for painting over or being left with factory finish. Flush mounted panels in finished walls shall be painted to match wall, paint and paint preparation to be as specified by Architect. Panel covers to be painted off wall, then installed over painted wall surface. Trims to be separately packed and protected from scratching and marring. Refer to labeling requirements in 16050 Basic Materials and Methods.
- D. Panelboard trims to have concealed trim screws and door hinges, and a flush stainless steel cylinder lock with catch and coil spring loaded door pull equivalent to Square D "Mono-Flat". All panels shall be keyed alike.

- E. Where grounding conductors are shown or specified, provide each panel and distribution center with grounding bus to which the grounding conductors shall be connected, each having its own terminal or lug.
- F. Where Isolated Grounding (IG) conductors are shown or specified, provide each panel and distribution center with an Isolated Grounding bus to which the IG conductors shall be connected, each having its own terminal or lug. The IG grounding system shall be fully separated and insulated from the IG receptacle to the System Grounding Electrode. Provide a second ground bus bonded to the panelboard can for termination of conduit and equipment bonding conductors.
- G. Panelboards rated 400 amps or less shall not exceed 6" depth.
- H. Provide fully rated equipment greater than or equal to the interrupting capacities indicated on the drawings.
- I. Provide all copper bus bars, 100% rated neutral bus, ground bus and isolated ground bus where indicated. Lugs shall be rated for copper only, CU-AL rated lugs shall not be allowed.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Breaker handle guards shall be provided on each circuit supplying obviously constant loads to prevent accidental shutting off. Such loads are refrigeration, contactor controlled circuits, freeze protection, etc.
- B. Furnish and install three spare one inch conduits from the top of each recessed panel, to an accessible point above the ceiling.
- C. Care shall be taken to terminate ground conductors from isolated ground receptacles only on the isolated ground bus in a panel. Do not terminate bonding conductors on an isolated ground bus.

END OF SECTION

SECTION 16478 – TRANSIENT VOLTAGE SURGE SUPPRESSORS

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Furnish all labor, materials, equipment and services necessary for and incidental to the installation of the Transient Voltage Surge Suppression (TVSS) System components at locations shown on the plans.

1.2 QUALITY ASSURANCE:

- A. The TVSS shall be UL Listed as a Transient Voltage Surge Suppressor, category C, UL 1449 Second Edition (including Sections 34 and 37.3, effective February 7, 2007). All UL 1449 test data shall be provided with submittal.
- B. The TVSS shall bear suppressed voltage rating issued by UL, and the units shall be tested in accordance with ANSI/IEEE C62.41-1991, Category C, 20kV/10kA, 8x20 uS and 1.2x50 uS Combination Waveform and .5uS - 100kHz Ring Wave with a minimum of 10 sequential impulses delivered directly into the TVSS at a maximum of sixty second intervals for each waveform.
- C. Manufacturers Qualifications: Only firms regularly engaged in the manufacture of TVSS products for category C (ANSI/IEEE C62.41), and whose products have been providing satisfactory service for not less than five years, shall be considered. Manufacturer qualifications shall be provided as part of the submittal.
- D. The TVSS must be capable of surviving 1000 sequential surges without failure, using IEEE test procedures established in C62.45.
- E. The TVSS device must have MOV surge devices, installed with full rating indicated between Phase to Neutral, Phase to Ground, and Neutral to Ground, and be capable of handling a minimum surge current as follows:

Branch panels:

Per Mode:

Line to Neutral 40,000 amps

Neutral to Ground 40,000 amps

Per Phase: 80,000 amps

1.3 SUBMITTALS:

- A. Submit complete and descriptive shop drawings in accordance with the General Conditions, Division 1, and Section 16050.
- B. Submit all related TVSS Specifications and drawing information requested in this document and U.L. 1449 Second Edition surge suppression ratings for the TVSS. In order for a TVSS system to be considered, all responses to information requested in this specification must be provided in writing. If a manufacturer cannot comply with any portion of this specification, this must be stated in the reply and the reason for non-compliance shall be provided.
- C. Submit operation and maintenance data in accordance with the General Conditions, Division 1, and Section 16050.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Provide products of one of the following manufacturers:
 - 1. Liebert
 - 2. LEA International
 - 3. Current Technologies
 - 4. Advanced Protection Technologies
 - 5. Intermatic Inc.
 - 6. GE Power Quality
 - 7. Cutler Hammer Clipper
 - 8. Square D
 - 9. Siemens
 - 10. EFI
- B. Requests for substitution of other products will be considered if submitted in accordance with the General Conditions, Division 1 and section 16050.

2.2 TVSS EQUIPMENT:

- A. The TVSS shall be suitable for application in category C environments as described in ANSI/IEEE C62.41. The TVSS shall be of parallel design and provide protection from Line to Ground, Line to Line, Line to Neutral, and Neutral to Ground.
- B. The TVSS shall be compatible with the electrical system voltage, current, configuration and intended application.
- C. The TVSS maximum continuous operation voltage (MCOV) shall be capable of sustaining 100% of the nominal RMS voltage continuously without degradation.
- D. The TVSS shall only use solid state clamping components connected in parallel with the supply to limit the surge voltages. Clamping components shall be installed in 7 modes. Four mode TVSS devices are not acceptable.
- E. Provide visual or audible indication of properly performing protection.
- F. Provide a surge counter.
- G. TVSS shall be integral to panels and switchboards.
- H. Warranty shall be for full replacement without pro-rating value, for a minimum period of 5 years.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Ship with complete installation instructions which are to be followed in detail. The manufacturer's representative is to be contacted and is to supervise the installation.
- B. Installation shall comply with all applicable State and National Electrical Codes, including NEC Articles 240, 250, 310 and 280. Provide overcurrent protection and a means to disconnect power from unit. All fuses utilized for the TVSS overcurrent protection shall be of the Time Delay type rated for the available fault current at the location of installation.
- C. Phase, neutral and ground leads of installed TVSS must be grouped and twisted together up to the point of connection at the bus or overcurrent device. Lead lengths must be as short as possible, avoiding bends where possible. In no case will lead lengths greater than sixteen inches or sharp bends in leads be permitted. Lead length is measured from switchboard bus or breaker to point of connection to TVSS device.
- D. Conductors must terminate with compression type lugs.
- E. Mount so that suppressor indicator lights will be clearly visible after installation.
- F. Overcurrent and disconnect devices shall be exclusively utilized for the TVSS device.

- G. Raceway from TVSS to switchboard shall consist of rigid steel conduit with double locknuts and grounding bushings connected to switchboard ground.
- H. Overcurrent protection sizing shall be as per manufacturers instructions. Conductor sizing shall be based on NEC requirements.

END OF SECTION

SECTION 16500 - LIGHTING

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Provide light fixtures with lamps and accessories as herein specified and shown on the drawings.

1.2 QUALITY ASSURANCE:

- A. If the catalog number of a specified fixture should conflict with the fixture description or the general lighting specifications, such conflicts shall be brought to the attention of the Architect prior to bidding.

1.3 SUBMITTALS:

- A. Submit product data and shop drawings for fixtures, ballasts, and lamps in accordance with the General Conditions, Division 1, and Section 16050.
- B. Verify that fixture description matches that which is indicated by the specified catalog number.
- C. All features mentioned in the fixture list shall be marked on the submitted items.
- D. Submit written confirmation that dimming ballasts and dimming controls are compatible.
- E. Submit Operation and Maintenance data in accordance with the General Conditions, Division 1, and Section 16050.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. See Luminaire Schedule for acceptable manufacturers.
- B. Requests for substitution of other products will be considered if submitted in accordance with the General Conditions, Division 1, and Section 16050.
- C. Substitution requests for fixtures equal to those specified shall include complete construction and photometric data including, if applicable, candlepower distribution curve, spacing to mounting height ratio, table of coefficients of utilization, isofootcandle curve, ANSI beam spread classification, efficiency, etc.
- D. Submittals and substitution requests for fluorescent fixtures shall include the sheet metal gauge of the housing and the lens thickness, material, and pattern.

2.2 MATERIALS:

- A. Polystyrene lenses and lenses less than 0.125 inches nominal thickness shall not be permitted unless otherwise noted.
- B. Provide luminaires with Area Coverage, damp, or wet label if required for the application indicated.
- C. All recessed luminaires shall be free of light leaks.

2.3 BALLASTS:

- A. All ballasts shall be capable of providing reliable operation of the lamps at the lowest temperature normally encountered. The contractor shall confirm that the ballasts are appropriate for the ambient conditions.
- B. The contractor shall verify the ballast voltage prior to submittal.
- C. Ballasts deemed excessively noisy shall be replaced without cost to the Owner.
- D. PREMIUM T8 BALLASTS – INSTANT START: Premium T8 fluorescent ballasts, unless noted otherwise on Light Fixture Schedule, shall be instant start electronic type; ballast data as follows:

UL listed and CSA certified.
Low wattage, ballast factor of 0.75 to 0.78
Similar light output with Premium lamp to standard T8 ballast and lamps.
Recognized Testing Laboratory listed, thermally protected, resetting, Class P, non-PCB, sound rated A.
Operate lamps at a frequency of 40KHz or higher with no detectable flicker.
Total Harmonic Distortion (THD) of 10% or less.
Power factor equal to or greater than 98%.
Minimum lamp starting temperature of 50 degrees F.
Meet all current Federal, State and Power Co. efficiency and efficacy standards, and rebate program requirements.
Meet all current ANSI, IEEE, and FCC regulations for EMI/RFI, harmonic distortion, and transient protection.
Provide extended lamp life as stated by lamp manufacturer.
Minimum 5 year ballast and replacement labor warranty by manufacturer.
Ballast manufacturer's data must be included with lighting fixture submittals.
Compatible with occupancy sensor switching.

Approved manufacturers: Advance (Centium or Optanium), Osram Sylvania, Magnetek, or approved.

- E. DIMMING T8, T5, BIAx, and COMPACT FLUORESCENT BALLASTS – PROGRAMMED START: programmed start dimming fluorescent ballasts, unless noted otherwise on Light Fixture Schedule, shall be electronic type; ballast data as follows:

UL listed and CSA certified.
100% to 5% full range flicker free continuous dimming using 0-10 VDC signal.
Recognized Testing Laboratory listed, thermally protected, resetting, Class P, non-PCB, sound rated A.
Operate lamps at a frequency of 40KHz or higher with no detectable flicker.
Total Harmonic Distortion (THD) of 10% or less.
Power factor equal to or greater than 95%.
Lamp starting at any light output setting.
Meet all current Federal, State and Power Co. efficiency and efficacy standards, and rebate program requirements.
Meet all current ANSI, IEEE, and FCC regulations for EMI/RFI, harmonic distortion, and transient protection.
Provide normal lamp life as stated by lamp manufacturer.
Minimum 5 year ballast and replacement labor warranty by manufacturer.
Ballast manufacturer's data must be included with lighting fixture submittals.
Compatible with occupancy sensor switching.

Approved manufacturers: Advance (Mark 10), Lutron, or approved.

Coordinate dimming ballasts with dimming controls specified in separate section.

F. STANDARD COMPACT FLUORESCENT BALLASTS – PROGRAMMED START:
Compact fluorescent ballasts, unless noted otherwise on Light Fixture Schedule, shall be programmed start electronic type; to operate 4 pin compact fluorescent lamps, ballast data as follows:

UL listed and CSA certified.
Full light output.
Dual voltage rated 120/277
Capable of operating more than one lamp wattage for PL-T triple tube applications
Recognized Testing Laboratory listed, thermally protected, resetting, non-PCB, sound rated A.
Operate lamp(s) at a frequency of above 40 kHz.
Total Harmonic Distortion (THD) of less than 10%.
Programmed start.
Power factor equal to or greater than 98%.
Maximum lamp crest factor 1.7.
Minimum lamp starting temperature of 0 degrees F.
Meet all current Federal, State and Power Company efficiency and efficacy standards, and rebate program requirements.
Meet all current ANSI, IEE, and FCC regulations for EMI/RFI, harmonic distortion, and transient protection.
Provide normal lamp life as stated by lamp manufacturer.
Minimum 5 year ballast and replacement labor warranty by manufacturer.
End-of-life detection and shut-down circuitry that meets proposed ANSI/IEC standards.
Ballast manufacturer's data must be included with light fixture submittal.

Approved manufacturers: Advance, Osram Sylvania, Magnetek, Howard Industries, or approved.

- G. STANDARD T5 and T5HO FLUORESCENT BALLASTS – PROGRAMMED START: T5 and T5HO fluorescent ballasts, unless noted otherwise on Light Fixture Schedule, shall be programmed start electronic type; ballast data as follows:
- UL listed and CSA certified.
 - Full light output.
 - Dual voltage rated 120/277
 - Recognized Testing Laboratory listed, thermally protected, resetting, non-PCB, sound rated A.
 - Operate lamp(s) at a frequency of above 40 kHz.
 - Total Harmonic Distortion (THD) of less than 10%.
 - Programmed start.
 - Power factor equal to or greater than 98%.
 - Maximum lamp crest factor 1.6.
 - Minimum lamp starting temperature of 0 degrees F.
 - Meet all current Federal, State and Power Company efficiency and efficacy standards, and rebate program requirements.
 - Meet all current ANSI, IEE, and FCC regulations for EMI/RFI, harmonic distortion, and transient protection.
 - Provide normal lamp life as stated by lamp manufacturer.
 - Minimum 5 year ballast and replacement labor warranty by manufacturer.
 - End-of-life detection and shut-down circuitry that meets proposed ANSI/IEC standards.
 - Ballast manufacturer's data must be included with light fixture submittal.

Approved manufacturers: Advance Centium, Osram Sylvania, Magnetek, or approved.

- H. Three or four lamp fluorescent fixtures located within 10 feet of each other, and arranged for 2 or 3 level lighting shall have master/slave ballasts wired in such a manner that a single switch shall not operate the outer lamps in some fixtures, and the inner lamps in others. One ballast shall serve outer lamps and the other shall serve inner lamp(s).
- L. In indoor locations other than dwellings or hazardous locations, fluorescent luminaires that utilize double-ended lamps and contain ballast(s) that can be serviced in place shall have a quick disconnecting means factory installed, internal to the luminaire, and accessible from the ballast housing. The quick disconnect shall simultaneously break all of the supply conductors to the ballast, including the neutral. The line side terminals of the disconnect shall be guarded.

2.4 LAMPS:

- A. Provide Premium grade, high performance T8 lamps, low mercury TCLP complaint (green ends), 3100 lumens, 3500°K, CRI of 82.
- B. T5, Biaxial, and compact fluorescent lamps shall be 3500°K type with a minimum CRI of 82, unless otherwise noted. Provide low mercury TCLP compliant lamps (green ends) where available as standard products (Philips Alto series or equal).
- C. All incandescent lamps shall be 130 volt, inside frosted unless otherwise noted (except Halogen).

- D. Acceptable lamp manufacturers are Venture, Osram/Sylvania, Philips, and General Electric.
- E. All lamps and fixtures shall be in proper operation at the time of acceptance.
- F. SPARE LAMPS: Provide ten percent spare lamps, with a minimum of two, for each size and type used.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Luminaires installed under this work shall be properly and adequately supported from the building structure except where ceiling construction or other provisions are specifically designed to support the fixture units. Fixture support systems shall provide a safety factor of four. This shall apply to chains, hangers, anchors, clamps, screws, and all other hardware and appurtenances associated with the support system.
- B. Fixture supports shall provide proper alignment and leveling of fixtures, and shall be arranged to maintain the alignment at all times. The final decision as to adequacy of alignment shall be given by the Architect.
- C. All light outlets shall be supplied with a fixture. Outlet symbols on the drawings without a type designation shall have a fixture the same as those used in similar or like locations.
- D. Fixture stem or chain lengths for industrial reflector or bare lamp strip fixtures shall be appropriate for the space and for coordination with other work such as ducts and piping. Provide swivel hangers for stem-hung fixtures.
- E. Fixtures shall be left clean at the time of acceptance of the work and every lamp shall be in operation. The responsibility for cleaning or protecting fixtures from dirt, dust, paint, debris, etc. shall rest with the Contractor performing this division of work.
- F. Prior to the purchase of any luminaire, the finish shall be verified with the Architect and the voltage shall be verified based on the panelboard voltage.
- G. Fixtures of a given description may be used in more than one type of ceiling. Consult the Architectural Reflected Ceiling plan to obtain this information. Some ceiling types may have changed immediately prior to bidding or by addenda or change order and the changes may not be reflected in the fixture list or fixture designations as shown on the plans. The contractor shall compare the electrical plans with the reflected ceiling plan and confirm that the specified fixtures are compatible with the ceiling system prior to ordering.
- H. Provide seismic support wires for all recessed fixtures where ceiling framing is not designed for fixture support.
- I. Provide all recessed lay-in fixtures a flexible power whip of at least 48 inches but not exceeding 72 inches. Where using modular wiring systems, wiring shall be supported from structure, not laying on ceiling tiles.

- J. Where fixtures are mounted under cabinets, in soffits, coves, or other physically restricting spaces, the contractor shall verify that the fixtures will fit the space prior to ordering.
- K. Undercabinet and similar fixtures are to be hard wired. Flexible cords similar to SO cord are not acceptable.
- L. Air supply fixtures shall be supplied with pattern control vanes.
- M. See Architectural plans for fire rated ceilings and coordinate fixture installation with general contractor to assure continuity of fire rating.
- N. Do not mount fluorescent or H.I.D. fixtures within 12" of any cable tray or telecommunications cable.
- O. Where dimming systems are specified, contractor shall operate fixtures at full intensity for a minimum of 100 hours prior to testing. Lamps shall not be dimmed until the 100 hours is complete.

END OF SECTION

SECTION 16530 – LIGHTING CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Provide manual and/or automatic control for all lighting fixtures shown. Exit and emergency pathway lighting shall be controlled at branch circuit panel only.
- B. Provide one low voltage relay for each 120 or 277 volt, 20 amp, 1 pole lighting branch circuit except for exit and pathway lighting circuits. Mount relays in cabinets and locate relay cabinets adjacent to the lighting branch circuit panels.

1.2 RELATED WORK:

- A. Section 16050: Basic Electrical Materials and Methods
- B. Section 16110: Raceways
- C. Section 16120: Wires and Cables
- D. Section 16141: Switches and Receptacles
- E. Division 15: Energy management system. All low voltage control wiring is included in Division 15 control section except as specified.

1.3 SUBMITTALS:

- A. Submit catalog data of relays and cabinets. All equipment must be UL listed.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Relays and cabinets, low voltage switches: All components must be of the same manufacture; acceptable manufacturers are: Sierra, General Electric, Pass and Seymour or approved substitute.
- B. Relays: Electrically operated, mechanically held; 20 amp, 277 volt or 120 volt contact rating. Momentary switching voltage: 24 VAC. GE No. RR-7. Provide quantity of relays as shown plus 2 spare relays per cabinet.

- C. Cabinet: Flush mounted metal enclosure with screw on cover, rust proofed and painted to match branch circuit panels; barrier between line and low voltage section with knockouts for mounting up to 12 relays minimum; barrier to be vibration isolated from box. Each box to be assembled and provided with low voltage, line voltage terminal strips and relays only; all terminal strips shall be numbered.
- D. Low voltage switches: Shall match standard toggle switch type and color; momentary contact switch with side wired terminals, with standard switch plate, SPDT normally open. GE 5935 series.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Label all relays and terminal strips with numbers to match panel branch circuit numbers. Provide relay directory on inside of cabinet identifying each relay and associated branch circuit.
- B. Provide all line voltage wiring from panel to relays and from relays to loads. Provide all low voltage wiring from relays to terminal strips in relay cabinet.

END OF SECTION

SECTION 16550 – OCCUPANCY SENSED LIGHTING CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. The Contractor shall provide all labor, materials, tools, appliances, control hardware, sensor, wire, junction boxes and equipment necessary for and incidental to the delivery, installation and furnishing of a completely operational occupancy sensor lighting control system, as described herein.
- B. The Contractor shall examine all general specification provisions and drawings for related electrical work required as work under Division 16.

1.2 SUBMITTALS:

- A. Submit complete and descriptive shop drawings including floor plans, layouts, catalog cuts and other descriptive data indicating compliance with the specifications herein. Submit data sheets on sensors, control units and all junction boxes and mounting accessories, including all wiring diagrams. Provide a complete layout of occupancy sensors including: location, coverage pattern, direction, and type. Submit in accordance with Section 01300.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. The Watt Stopper, Inc., Mytech/Hubbell, Leviton, Novitas
- B. Requests for substitution of other products will be considered if submitted in accordance with the general conditions and Division 1.
- C. All sensors shall be California Energy Commission Title 24 approved and certified.

2.2 WALL SWITCH INFRARED TYPE (For Offices up to 150 square feet).

- A. Wall switch sensors shall be capable of detection of motion at desk top level up to 500 square feet.
- B. Wall switch sensors shall accommodate loads indicated on the plans.
- C. Coverage of 180 degrees
- D. Digital auto-OFF time delay adjustable from 30 seconds up to 30 minutes.
- E. Adjustable unit sensitivity.

- F. Integrated light level sensor - works from 2.4 to 300 footcandles
- G. LED for sensitivity calibration
- H. Transformer / latching relay design.
- I. Works with electronic ballast and high power factor PL lamp ballasts.
- J. No leakage current in off mode.
- K. Voltage drop protection.
- L. Watt Stopper Model WS 120 / 277

2.3 CEILING MOUNT INFRARED TYPE (For offices up to 300 square feet)

- A. Shall utilize custom ASIC specifically designed for PIR occupancy sensors which provides high immunity to RFI and EMI.
- B. Shall have user-adjustable sensitivity setting and adjustable time delay of 30 seconds to 30 minutes.
- C. Shall have in place a by-pass pin which when removed will override sensor to ON and which requires no rewiring or modification to unit.
- D. Shall have a daylight filter which insures that the sensor is insensitive to short-wavelength infrared waves such as those emitted by the sun.
- E. Shall have the ability to sense directly under and slightly behind sensor when mounted on ceiling.
- F. Shall not protrude more than 1 1/4 inches from the ceiling (or wall).
- G. Adjustments and mounting hardware shall be concealed under a removable cover to prevent tampering of adjustments and hardware.
- H. Shall operate from a 24 volts DC power supply: current draw of 14 milliamps.
- I. Watt Stopper Model WPIR

2.4 CEILING MOUNT INFRARED TYPE (For Offices, Conferences Rooms up to 900 square feet).

- A. Shall use custom ASIC specifically designed for PIR occupancy sensors which provides high immunity to RFI and EMI.
- B. Shall have two outputs; one output is based on occupancy only and one is based on occupancy with a hold OFF and an internal photocell setting when a minimum light level is present (adjustable from 3 to 200 footcandles).
- C. Shall have a digital time delay setting adjustable from 15 seconds to 30 minutes.

- D. Shall be furnished with a DIP switch override-ON function for use in the event of failure.
- E. Shall have an additional single pole, double throw isolated relay with normally open, normally closed, and common outputs rated at 1 Amp for 24 VDC. The isolated relay is for use with HVAC control, data logging, and other control options.
- F. Shall have a standard 30 element Fresnel lens with 15 layers horizontally and 4 layers vertically, a 14 element Long Range Fresnel lens with 9 layers horizontally and 4 layers vertically, or an Aisle Way Fresnel lens with 14 layers horizontally and 9 layers vertically.
- G. Shall cover up to 1200 square feet with the Standard Lens, up to 90 linear feet with the Long Range Lens, and up to 120 linear feet with the Aisle Way Lens for walking motion when mounted at a ceiling height of 12 feet.
- H. Shall operate on 24 VDC, current draw of 19 Ma.
- I. Watt Stopper Model CX-100

2.5 CEILING MOUNT ULTRASONIC TYPE (For Restrooms, Open Office Areas up to 1000 square feet)

- A. Shall be omni-directional with volumetric coverage of 360 degrees and up to 1000 square feet of walking motion.
- B. Shall have a multi-direction transmitter with temperature and humidity resistant, minimum 32 kHz tuned ultrasonic receivers. Ultrasonic receivers shall be temperature and humidity resistant with less than a 6dB shift in the humidity range of 10% to 90% and less than a 10dB shift in the temperature range of -20 to 60 degrees C.
- C. Sensors of varying frequencies shall not be allowed so as to prevent sensors from interfering with each other and to ensure compatibility in the event more sensors are added or units are replaced.
- D. Shall be furnished with a convenient shunt provision which will enable a by-pass in the event of failure. This by-pass provision pin shall remain in the sensor and be visible from the floor as a constant reminder that the automatic function has been by-passed.
- E. Shall have user-adjustable sensitivity setting and time delay setting from 15 seconds to 15 minutes.
- F. Shall operate on 24 VDC, current draw of 15 mA.
- G. Watt Stopper Model W-1000A

2.6 CEILING MOUNT DUAL-TECHNOLOGY TYPE (For Rooms up to 1200 SF)

Low Profile, ceiling mount, 360 degree coverage:	Watt Stopper Model DT-300
Adjustable arm, wall mount, 180 degree coverage:	WattStopper Model DT-200

- A. The Occupancy Sensors shall be capable of detecting presence in the floor area to be controlled, by detecting doppler shifts in transmitted ultrasound and passive infrared heat changes (dual technology). Sensors that utilize microphonics are not approved.
- B. Upon entering a space, motion from both technologies must be sensed before lighting will be turned on. After this has occurred, detection in either technology will hold lighting on for the set time period. Sensors will have a retrigger time delay where only one motion is necessary to turn on the lights within 5 seconds after turning off.
- C. Ultrasonic sensors will be volumetric in coverage. Up to 10 different passive infrared patterns will be available by lens selection. Detection shall be maintained when a person of average size and weight moves only within or a maximum distance of twelve inches either in a horizontal or vertical manner at the approximate speed of 12 inches per second. The sum of this distance, volume and speed represent the average condition an Occupancy Sensor must meet in order that the lights will not go off when a person is reading or writing while seated at a desk.
- D. Sensors will cover a minimum of 1500 square feet when mounted at 12 feet.
- E. The sensors are designed to be ceiling mounted and not protrude more than 2 inches and should blend in aesthetically with the space.
- F. Each sensing technology shall have independent sensitivity adjustments and LED display.
- G. Time Delay range shall be adjustable from 15 seconds to 15 minutes.
- H. Sensors shall operate on 24 volts, 25 milliamps DC.
- I. Sensor shall have an additional single pole, double throw isolated relay with Normally Open, Normally Closed and Common outputs rated at 1 amp for 24 VDC. The isolated relay is for use with HVAC control, Data Logging, and other control options.
- J. Ultrasonic circuit shall be solid state, crystal controlled with signal processing filtering.
- K. Ultrasonic receivers shall be temperature and humidity resistant with less than a 6dB shift in the humidity range of 10% to 90% and less than a 6dB shift in the temperature range of -20o to 60o C.
- L. The ultrasonic frequency shall be 40 kHz + .006%.
- M. Ceiling mount sensors shall provide a minor motion coverage range of 250 to 1300 square feet with an overall 1/2 step coverage range from 500 to 2000 square feet.

- N. All sensors shall be capable of operating normally with electronic ballast and PL lamp systems.
- O. All sensors shall be self-contained, crystal controlled ultrasonic or infrared occupancy sensors located to provide coverage of 90 to 100% of the controlled area.
- P. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.
- Q. All sensors shall have readily accessible, user adjustable controls for time delay and sensitivity. Controls shall be recessed in the sensor to limit tampering.
- R. In the event of failure, a bypass manual "override on" shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed in the sensor to prevent tampering.
- S. Ultrasonic operating frequency shall be crystal controlled to within plus or minus 0.005% tolerance to assure reliable performance.
- T. Ultrasonic microphone receiver frequency shall be 25 KHz or greater and shall be temperature and humidity resistant.
1. All sensors shall provide a red LED indication light to verify that motion is being detected and that the unit is working.
- U. All ultrasonic sensors shall comply with the State of California Safety and Health Requirements. Decibel levels for ultrasonic sensors shall comply with the following California Energy Commission criteria:
- | Midfrequency of Sound
Pressure Third Octave | Minimum dB level within
Third Octave Band (in dB
Band (KHz) reference 20 micropascals) |
|--|--|
| Less than 20 | 80 |
| 20 or more to less than 25 | 105 |
| 25 or more to less than 31.5 | 110 |
| 31.5 or more | 115 |
- The Contractor shall certify in writing that installed sensors comply with the specified California Energy Commission criteria for ultrasonic sound.
- V. All sensors shall have no leakage current in OFF mode and shall have voltage drop protection.
- W. Sensors shall be suitable for N.E.C. 725 Class 2 wiring and use plenum cable where approved. Where plenum cable is not approved, provide conduit to within 6 inches of sensor location.

2.7 POWER PACKS:

- A. Power Packs shall be mounted on external J boxes and be an integrated self-contained unit consisting of a load switching relay and a transformer.
- B. Relay Contacts shall have ratings of:
 - 10A - 120 VAC Tungsten
 - 20A - 120 VAC Ballast
 - 15A - 277 VAC Ballast
- C. Relay contacts shall be isolated.
- D. Power Packs: Wattstopper A-120E, A-277E
- E. Between sensors and controls units shall be three (3) conductors, 18 AWG, stranded U.L. Classified, PVC insulated or TEFLON jacketed cable approved for use in plenums. One sensor shall be capable of driving four Power Packs.
- F. Enclosures for Power Packs shall be NEMA I construction with mounting and barriers to provide separation between line and low voltage wiring or a standard four (4") inch junction box with control unit mounting to cover plate with ½ inch knockout. Boxes not located above accessible ceilings shall be painted to match finish color of mounting surface.
- G. Occupancy sensors shall have calibration at the occupancy sensor head, not at the power pack above the ceiling.

PART 3 - EXECUTION

3.1 PERFORMANCE:

- A. The objective of this section is to ensure the proper design and installation of the occupancy sensor based fluorescent lighting control system in rooms designated on the drawings so that lighting is turned off automatically after reasonable time delay when a room or area is vacated by the last person to occupy said room or area.
- B. The occupancy sensor based lighting control shall accommodate all conditions of space utilization and all irregular work hours and habits.

3.2 DESIGN:

- A. It shall be the contractor's responsibility to contact the Manufacturers Representative and, with their assistance, aim and locate sensors correctly as required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas. Rooms shall have ninety (90) to one hundred (100) percent coverage to adequately cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the rooms(s). The sensor symbols shown on the drawings are

diagrammatic and indicate only rooms which are to be provided with sensors. The contractor shall provide sensors as required to properly and completely cover the respective room. Proper judgment must be exercised in executing the work so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components. Sensors in small offices should be located to avoid false operation caused by persons walking by the door and outside the office.

- B. Mount occupancy sensors a minimum of 8 feet away from HVAC diffusers. Ultrasonic sensors shall be mounted on vibration free, stable surfaces and shall not be used in areas of heavy air flow, moving objects, or on ceilings over 14 feet high.
- C. Where "override-OFF" switch is required, switch is to be connected on the load side of the Power Pack Relay.

3.3 WARRANTY:

- A. Contractor shall warrant the system including all equipment furnished in accordance to this specification to be undamaged, free of defects in materials and workmanship, and in conformance with the specifications. The suppliers obligation shall include repair or replacement, and testing without charge to the owner, all or any parts of equipment which are found to be damaged, defective or non-conforming and returned to the supplier. Warranty on sensors and controls units will be for a period of five (5) years. The warranty shall commence upon the owner's acceptance of the project. Warranty on labor shall be for a minimum period of one (1) year.

3.4 OWNER TRAINING:

- A. The contractor shall provide, at the owner's facility, the training necessary to familiarize the owner's personnel with the operation, use, adjustment, and problem solving diagnosis of the occupancy sensing devices and systems.

END OF SECTION

SECTION 16621 – ENGINE GENERATORS

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. The generator has been ordered by the owner as a separate package and shall be delivered to the contractor on-site. Generator material cost and shipping to site are covered under a separate package and shall not be part of this bid package.
- B. The Contractor take deliver of the generator, secure, store and install a standby diesel engine/generator system of the latest commercial type and design, complete with all accessories necessary for a complete operational system, suitable for use as a legally required emergency standby power system.

1.2 QUALITY ASSURANCES:

- A. The engine generator assembly shall be UL 2200 listed.

1.3 WARRANTY:

- A. Warranty shall be covered by others under another contract as part of the separate generator package.

PART 2 - EXECUTION

2.1 INSTALLATION:

- A. Provide branch circuits and power and control connections for all accessories. Coordinate damper voltage with Controls Contractor.
- B. Install signaling and control circuits as required for remote annunciator, battery charger alarm, automatic start-stop of generator set by automatic transfer switch, lighting control panel, damper motors, etc.
- C. Confirm that there is a neutral and ground path back to the main service ground. The ground path must be through wire in conduit. Using raceways for the ground path is not acceptable.
- D. Prior to running circuits and ordering branch circuit breakers, confirm that the block heater electrical characteristics match the branch circuits shown.

2.2 INSPECTION & TESTING:

- A. Prior to acceptance of the installation, equipment shall be tested by a factory-trained dealer service representative to show it is free of any defects, will start automatically, and be subjected to full-load tests. Provide a load bank with sufficient capacity to operate the

generator system at full load. On completion of the installation, start-up shall be performed by a factory-trained dealer service representative. All testing shall be performed in the presence of the Engineer or his designated representative.

B. FULL BUILDING LOAD TEST

Allow the generator to operate for 3 hours on building load and record the following information at 15 minute intervals.

Load amps per phase
Load kw per phase
Line to Line Voltages
Frequency
Coolant Temp
Oil Pressure

C. ONE STEP FULL LOAD TEST

With all transfer switches in the normal position, add load bank until the generator is loaded to 100% of capacity. Do not use building load for this test. Shut down the generator and simulate a power failure by opening the normal source breakers to the automatic transfer switches. Record the voltage and frequency stability at each step with a power line analyzer.

D. 50% LOAD STEP TEST

Reduce the load on the generator by approximately 40 to 60% as a single step, and then re-add the load. Record the voltage and frequency stability at each step with a power line analyzer.

E. LOAD SHED SYSTEM TEST

Demonstrate proper operation of the load shed system.

F. FOUR HOUR TEST

Load the system to 100% of capacity. Run the system for 4 hours and record the coolant temperature, oil pressure, load, voltage, and frequency at 15 minute intervals.

G. DERANGEMENT ALARM TEST

Test all derangement alarms.

H. ANNUAL LOAD TESTING

At 12, 24, and 36 months items 2.2.B through 2.2G shall be tested by a factory-trained dealer service representative and any problems shall be fixed at no cost to the owner under the (3) year warranty. All annual tests are to be performed in the presence of the owner or owner's representative.

END OF SECTION

SECTION 16625 AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Automatic transfer switch(es) were bid as a separate package including materials and delivery.
- B. The Contractor take deliver of the transfer swichtes, secure, store and install a complete operational system, suitable for use as a legally required emergency standby power system.

PART 2 - EXECUTION

2.1 ACCEPTANCE AND INSPECTION:

- A. Record the following for each switch:
 - 1. Time delay on retransfer to normal.
 - 2. Transfer switch time in neutral position during retransfer to normal for each switch with a neutral delay.
 - 3. Time delay to engine shut down for the entire system.
 - 4. Transfer switches with in-phase monitors shall be tested as follows. Record the phase A voltage and frequency with a power line analyzer between the normal and the emergency source during the re-transfer. The waveshape printout must demonstrate the phase relation ship between the two sources at the moment of transfer.
- B. If a transfer switch feeds a UPS system, the contractor shall verify that the voltage threshold for the transfer switch is set to start the generator before the UPS would switch to battery power. This is to prevent running the UPS on battery power during a brownout that doesn't start the generator.
- C. Prior to acceptance of the installation, equipment shall be tested to show it is free of any defects.

END OF SECTION

SECTION 16740 – VOICE AND DATA WIRING

PART 1-GENERAL

1.1 WORK INCLUDED:

- A. Furnish and install all labor and materials required for the installation of a complete voice and data cable infrastructure.

1.2 QUALITY ASSURANCE:

- A. Do all work in accordance with the guidelines published in EIA/TIA standard 568 and 569. Where conflicts exist, the plans and specifications shall generally take precedence. Bring all such conflicts to the attention of the Architect for final resolution.
- B. All workers involved in the installation and termination of cable shall have at least one year of experience. All workmen on the job shall have attended a vendor sponsored training program covering installation and termination of cable.
- C. The Contractor installing the cable and components shall be approved by the manufacturer providing the 15 year warranty described below.

1.3 SUBMITTALS:

- A. Submit complete and descriptive shop drawings in accordance with Section 01300. Include data for wall jacks, cable, racks, patch panels, and a layout for each IDF and MDF terminal board.
- B. Submit floor plans indicating the boundaries for the area served by each IDF location. Clearly identify the boundaries on the as-built plans.

1.4 GUARANTEE:

- A. Guarantee all work against faulty and improper material and workmanship for a minimum period of one (1) year from the date of final written acceptance by Owner, except where guarantee or warranties for longer terms are specified herein.
- B. The warranty shall assure that all components, links, and channels shall equal or exceed the EIA/TIA standards including attenuation, NEXT, etc. for the duration of the warranty.
- C. Acceptable warranty providers are as follows.
Comscope/Systemax
Belden/Nordex
Siemens/Mohawk
Leviton/Superior Essex

- D. Upon notification of a problem, the warranty provider shall furnish within 48 hours and at no cost to the owner, such labor and materials as are needed to restore the system to proper operation.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. The structured cable system and all of its components and installation shall meet the requirements of the latest draft of the EIA/TIA performance standards for the category of cable and accessories specified elsewhere in this specification.
- B. All components shall be backwards compatible. They shall satisfy all requirements of their category in addition to all existing lower category specifications.

2.2 ACCEPTABLE MANUFACTURERS:

- A. Structured Cabling and Outlet Solutions:
Comscope/Systemax
Belden/Nordex
Siemens/Mohawk
Leviton/Superior Essex
- B. Ladder Tray: Hubbell, Chatsworth, Homaco, Ortronics
- C. Requests for substitution of other products will be considered if submitted in accordance with the General Conditions, Division 1, and Section 16050.

2.3 HORIZONTAL COPPER DISTRIBUTION

- A. All UTP cable shall be 4-pair cable, of 24AWG solid copper conductors under a common sheath. Cable must meet the requirement for Category 6 of EIA/TIA standards and be rated for use in the environment in which it is used.
- B. ■Voice and ■ Data■ UTP cables shall terminate on rack mount 110-type UTP terminating Category 6 modular RJ-45 patch panels and shall be provided and installed in equipment racks. They must meet requirements for Category 6 of EIA/TIA TSB-40. Rack mount wire management panels are to be installed for each 48 jack rack mount patch panel.
- C. All voice and data outlet plates shall be of a modular design capable of accepting interchangeable RJ-11, RJ-45, video F connectors, BNC, fiber ST, SC, or MT-RJ connectors, or blank inserts into a single plate. Inserts shall be designed to permit them to be disconnected from the plate without removing the cable, and reinstalled on another plate. Plates shall be single gang nylon, color to match adjacent power receptacle plates.
- D. All plates shall be 4 port with quantity of jacks as indicated elsewhere. Provide blank fillers in all unused ports.

- E. Each outlet shall have ■ three ■ UTP cables terminated on ■ three ■ CAT 6 RJ-45 jacks except as indicated otherwise on the floor plans by a numeric designation adjacent to the outlet symbols.
- F. Wall phone outlets shall have one 4 pair UTP cable terminated in a single gang plate.
- G. Wiring configuration (568A 568B) as directed by Owner.

2.4 LADDER TRAY:

- A. Where indicated on the plans, ladder bottom type cable tray is to be installed in each telecommunication room. Coordinate the installation of tray with all other construction within the telecommunications room.
- B. Channel type; steel; painted telephone equipment gray; complete with all necessary hardware and fittings for a complete installation; capable of supporting a cable load of a least 50 pounds per linear foot with side rail deflection not to exceed 0.5 inch at this load. Size as indicated.
- C. Trays shall be attached to tops of equipment racks where they pass over them. Cable tray to be firmly attached per the manufacturers instructions. Provide cable dropouts at locations where 5 or more cables will exit the tray.
- D. Provide seismic bracing acceptable to the code authorities having jurisdiction.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. The Contractor shall furnish and install all cabling in accordance with this specification, and as indicated on the cable schedules and drawings.
- B. Install each cable as an uninterrupted conductor section between the designated termination points, unless otherwise directed by the cable installation specifications. There shall be no splices or mechanical coupler installed between the cable points of origin and termination except as shown on drawings and or specifications.
- C. Unless otherwise noted, all cable shall be routed through conduit for entire length.
- D. Contractor is responsible for insuring that cable jacket is suitable for the environment in which it is placed ie: CM, CMR, CMP rated.
- E. All cable shall be attached to building structure except as noted below, at intervals not to exceed those mandated by the National Electrical Code.
- F. At the same time cable is pulled into a cable pathway, also install a pull string of appropriate size to facilitate future cable pulls along those pathways.

- G. Provide firestopping at all locations where cables penetrate fire rated surfaces. Materials and methods used shall be acceptable to the code authority having jurisdiction and shall maintain the fire integrity of the wall, floor, or ceiling.

3.2 CABLE IDENTIFICATION:

- A. Cable tags containing a unique cable ID designator shall be placed on both ends of all cables, 6 inches from the connector and /or termination blocks. Also label all backbone cables passing through telecommunications rooms. Each label shall be pre-printed with the appropriate cable number as indicated. Hand written cable labels are not acceptable.
- B. Individual station outlets shall be labeled with the designator of the cables terminated at that particular outlet.
- C. If at any time during the job the cable tag becomes illegible or removed for whatever reason, the Contractor shall immediately replace it with a duplicate pre-printed cable tag at the Contractor's expense.
- D. Labeling sequence to be determined by the Owner and to be followed by the contractor.

3.3 TELECOMMUNICATION ROOMS:

- A. Provide plywood backboards where indicated on the plans. Backboards to be 3/4" AC fire rated plywood, 8' tall, width as indicated on the drawings.

3.4 TERMINATION HARDWARE

- A. Quantities of termination blocks, racks, splice enclosures, and patch panels, etc. shown on drawings are illustrative only and are meant to indicate the general configuration of the work. The Contractor is responsible for providing the correct quantities of termination hardware required to terminate, patch, cross connect, etc. the volume of cable described herein and shown on the drawings. Rack quantities shall be no less than what is shown on the drawings.
- B. At all times during the construction, the Contractor shall protect the equipment from damage and theft. Equipment shall not be installed until such time as other trades have completed their work in the area.

3.5 CABLE TERMINATION:

- A. Twisted pair metallic cables: After dressing cable to it's final location the sheath shall be removed to a point that allows the conductors to be splayed and terminated in a neat and uniform fashion. Every effort must be made to maintain sheath integrity by removing only as much as is practical to accomplish termination. Cable pair twist shall be maintained up to the point of termination. Under no circumstances shall cable pairs be untwisted or otherwise altered prior to termination.

3.6 CROSS-CONNECT:

- A. Twisted pair metallic cable: Perform all necessary cross-connect and patches as indicated in these specifications. Utilize cross-connect wire, and 25 pair cable as necessary. Cut all cross-connect wire to length, leaving enough slack to form a "3-finger loop". After completion of work, dress patch cords and cross-connect wire in cable management apparatus. Do not tie-wrap cross-connect wires into bundles.
- B. The contractor is responsible for providing all cross-connect schedules and documentation for Contractor installed cross connects and patching, to the Owner/Consultant on completion of project.

3.7 GROUNDING:

- A. All metallic cable tray, ladder rack, raceways, cable sheath/armor, enclosures, and equipment racks and other conductive surfaces shall be properly bonded to the grounding system. All paint and other coatings shall be removed at all contact surfaces to ensure proper ground.
- B. Furnish and install an insulated # 6 copper ground wire from all telecommunication rooms to the main building electrical ground point in the main electrical room. Drawing notes indicating a larger size shall take precedence.
- C. All grounding shall be in compliance with the NEC code Article 800, Article 250, well as EIA/TIA standard 607.

3.8 CABLE TESTING:

- A. Copper
 - 1. Visually inspect all cables, cable reels, and shipping cartons to detect cable damage incurred during shipping and transport. Return visibly damaged items to the manufacturer.
 - 2. Conduct cable testing as described below upon completion of installation. Test fully completed systems only. Piecemeal testing is not acceptable, except by prior written approval from the Architect.
 - 3. After terminating both ends, but before any cross connects are installed, test all UTP voice and data station cables for attenuation and for near-end cross talk (NEXT) to ■ 100 ■ 250 ■ Mhz. Test all UTP backbone cable for cable pair/conductor continuity, ground fault, proper cross-connect, shorts and crossed pairs.

3.9 ACCEPTANCE:

- A. Upon receipt of the Contractor's documentation of cable testing, the Architect will review the installation and may request a test in his presence, of up to 1% of the cables/wires installed.

END OF SECTION

SECTION 16790 – ACCESS CONTROLS

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Provide card reader, door power supply(ies), door contacts, request to exit motion sensors as shown on the drawings. New equipment to match existing manufacturer equipment and be fully compatible with the existing system. Provide all necessary components for full integration to existing system.
- B. System shall include installation, equipment, wiring, materials, accessories, programming, documentation, testing and miscellaneous items required for a complete and operational system. Drawings indicate location of devices and existing central processing unit. Manufacturer or authorized factory representative shall design complete system including wiring and interfacing with the security system.

1.2 SUBMITTALS:

- A. Submit complete and descriptive shop drawings indicating compliances with the specifications herein. Submit in accordance with Section 01300.

1.3 RELATED WORK SPECIFIED ELSEWHERE:

- A. See Section 16050 Basic Electrical Materials and Methods.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Match existing.
- B. Request for substitution of other products will be considered if submitted in accordance with Division 1 requirements.

2.2 EQUIPMENT:

- A. Readers:
 - 1. Proximity card readers matching existing shall be provided.
- B. Wiring
 - 1. Provide all wiring required for system as recommended by manufacturer.
- C. Door hardware: See architectural door plans and specifications. Coordinate voltage of Electric Strikes and Magnetic holders with this system.

- D. Door frame contacts: Sentrol 1078 or equal magnetic door contact. Plastic plungers shall not be used.
- E. Provide battery backed up door power supplies matching the voltage and requirements of the specified electric strike hardware (refer to architectural door plans and specifications).

PART 3 -EXECUTION

3.1 INSTALLATION:

- A. The installation shall be accomplished with quality materials in a neat and workmanlike manner. Materials under this section or other sections of the specifications damaged during this installation shall be replaced with new materials at no additional cost to the Owner.
- B. Prior to beginning work, hold a coordination meeting which is to include the access controls subcontractor, automatic door installer, door hardware vendor and installer, and glazing subcontractor. Coordinate all interfaces between equipment, rough-in requirements, phasing issues, etc.
- C. All wiring shall be concealed in conduit which is concealed from sight.

3.3 INSPECTION:

- A. When all the equipment is properly installed, it shall be tested under the supervision of the factory representative. A deficiency list of all improper operating equipment or missing equipment shall be made. When all deficiencies are corrected and the equipment has been thoroughly tested, and at mutually agreed time, a final inspection shall be conducted. The final inspection team shall consist of the factory representative, the installer and the Owner's representative.

3.4 TRAINING

- A. Provide 4 hours of on site training utilizing the actual access control system. Training shall include at minimum the following: System programming, operating doors, photo badging and monitoring. At end of training, provide a certification letter indicating the training was given and understood by the attendees.

END OF SECTION